RESPONSE ACTION CONTRACT
FOR REMEDIAL RESPONSE, ENFORCEMENT OVERSIGHT,
CRITICAL REMOVAL ACTIVITIES AT SITES OF RELEASE OR
THREATENED RELEASE OF HAZARDOUS SUBSTANCES
IN EPA REGION II

FINAL WORK PLAN
VOLUME I

Maunabo Groundwater Contamination Site
Remedial Investigation/Feasibility Study
Maunabo, Puerto Rico
Work Assignment No. 171-RICO-02XF

U.S. EPA CONTRACT NO. 68-W-98-210
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Section 1
Introduction

CDM Federal Programs Corporation (CDM) received Work Assignment 171-RICO-02XF under the Response Action Contract (RAC) II to perform a Remedial Investigation/Feasibility Study (RI/FS) for the United States Environmental Protection Agency, Region II (EPA) at the Maunabo Groundwater Contamination site (the Maunabo site) located in Maunabo, Puerto Rico. The purpose of this work assignment is to evaluate the nature and extent of groundwater contamination, and determine the appropriate remedial alternatives for the identified contamination.

For presentation purposes, work plan figures and tables are presented at the end of Volume I.

1.1 Overview of the Problem

The overview of the Maunabo site is summarized from the Hazard Ranking System (HRS) package prepared by EPA Region 2 Site Assessment Team 2 (SAT 2) (EPA 2006a). Figure 1-1 is the Site Location Map and Figure 1-2 is the Site Map. Additional site history and background information are included in Section 2. Maunabo's public water system, known as Maunabo Urbano, consists of four groundwater wells: Maunabo #1, Maunabo #2 (Bordaleza), Maunabo #3 (Calzada), and Maunabo #4 (San Pedro).The Puerto Rico Department of Health (PRDOH) ordered the Puerto Rico Aqueduct and Sewer Authority (PRASA) to close Maunabo #1 in March 2002 because a chlorinated solvent was detected above the federal Safe Drinking Water Maximum Contaminant Level (MCL). PRASA opted to treat the groundwater with carbon filtration tanks at the wellhead rather than close the well in order to meet water supply needs. Since then, the detections of solvents in raw groundwater samples from Maunabo #1 have exceeded the MCL on numerous occasions. Samples taken after treatment, including tap water samples collected along the distribution system down-line from Maunabo #1, indicate that the treatment has not been effective.

In December 2005, SAT 2 conducted Preliminary Assessment/Site Inspections (PA/SI) at five industrial sites around the Maunabo area that could be potential sources of groundwater contamination. SAT 2 used direct-push technology and laboratory confirmatory analyses of soil and groundwater samples. Contamination was not documented at any of these potential sources. Based on these results, there is insufficient information to conclusively determine the source of contamination of the local public supply wells.

1.2 Approach to the Development of the Work Plan

CDM reviewed all available information on the Maunabo site prior to formulating the scope of work presented in this work plan. Section 8 provides a list of all documents reviewed and referenced during development of the work plan. The RI/FS for the site will include a RI, risk assessments (RAs), and an FS.

The RI will focus on collecting adequate data from appropriate media to characterize the nature and extent of groundwater contamination. The sampling approach is discussed in Section 5. A Quality Assurance Project Plan (QAPP) detailing sample and analytical requirements for the field investigation and a health and safety plan (HSP) will be submitted separately. The RI report will provide a complete evaluation of sampling results.

The RAs for the Maunabo site will evaluate the risk from exposure to contaminated groundwater. The human health RA (HHRA) will be conducted according to EPA's *Risk Assessment Guidance for Superfund* (EPA 1989a and EPA 1998a) or according to the most recent EPA guidance and requirements. The screening level ecological risk assessment (SLERA) will be conducted according to EPA's *Ecological Risk Assessment Guidance for Superfund, Process for Designing and Conducting Ecological Risk Assessments* (ERAGS) (EPA 1997c) or according to the most current EPA guidance and requirements. The risk assessments will include a list of contaminants of potential concern (COPCs); toxicology of COPCs; transport, degradation, and fate analysis of COPCs; comparison of COPCs to applicable or relevant and appropriate requirements (ARARs); and determination of potential risk.

An FS will be completed in accordance with EPA guidance under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) *Interim Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988), or the most recent EPA FS guidance document. The FS will develop and screen remedial alternatives and provide detailed analysis of selected alternatives, including the "No Action" alternative. The remedial alternatives will be evaluated against the nine criteria required by EPA guidance documents: (1) overall protection of human health and the environment; (2) compliance with ARARs; (3) long term effectiveness and permanence; (4) reduction of toxicity, mobility, or volume through treatment; (5) short-term effectiveness; (6) implementability; (7) cost; (8) state acceptance; and (9) community acceptance.

1.3 Work Plan Content

This work plan contains nine sections, as described below.

Section 1	Introduction - The introductory section lays out the format of the work plan.
Section 2	Site Background and Setting - This section describes the site background, including the current understanding of the location, history, and existing conditions at the site.
Section 3	Initial Evaluation - This section presents the initial evaluation of existing data; it includes a description of previous sampling results, site geology and hydrogeology, the current conceptual site model (CSM), and a preliminary identification of ARARs.

Section 4	Work Plan Rationale - This section includes the Data Quality Objectives (DQOs) for the RI sampling activities and the approach for preparing the work plan to satisfy the DQOs.
Section 5	Task Plans - This section presents a discussion of each task of the RI/FS in accordance with the Maunabo site RAC II Statement of Work (SOW) and discussions with EPA.
Section 6	Schedule - The project schedule is presented in this section.
Section 7	Project Management Approach - Project management considerations that define relationships and responsibilities for selected task and project management teams are described.
Section 8	References - The references used to develop material presented in this work plan are listed in this section.
Section 9	Glossary of Abbreviations - The acronyms and abbreviations used in the work plan are defined in this section.

Section 2
Site Background

2.1 Site Location and Description

The Maunabo Groundwater Contamination site is located in the municipality of Maunabo, in the southeastern coastal area of Puerto Rico (18' 00' 20.6" north latitude and 65' 54' 19.5" west longitude). The Maunabo Groundwater Contamination site consists of a groundwater plume with no identified source(s) of contamination. The size of the plume of contamination has not been determined. Figure 1-1 shows the site location.

The Maunabo Urbano public water system consists of four groundwater wells: Maunabo #1, Maunabo #2 (Bordaleza), Maunabo #3 (Calzada), and Maunabo #4 (San Pedro). Groundwater contamination has been detected in two of the supply wells, Maunabo #1 and Maunabo #4. All four public supply wells are finished to depths ranging from 80 to 125 feet below ground surface (bgs) in the Maunabo alluvial valley aquifer. This aquifer generally consists of poorly sorted sand, silt, clay, and gravel alluvium, including lenticular deposits of sand, gravel, and cobbles. The regional direction of groundwater flow in the Maunabo basin is southeast toward the Caribbean Sea.

The Maunabo basin covers about 18 square miles, of which 3.5 square miles comprise an alluvial valley. This area is surrounded by hills ranging from 150 to 1,700 feet above mean sea level (amsl), except to the east where it is bounded by the Caribbean sea. The area is drained by Rio Maunabo, which has headwaters at Cerro LaTorresilla. Tributaries of Rio Maunabo head in the foothills to the north and south of this alluvial valley.

The Maunabo Urbano public water supply system serves a total population of 13,988 people apportioned equally among the four wells (i.e., 3,497 per well). Therefore, the contaminated wells in this system, Maunabo #1 and #4, serve almost 7,000 people. Wellhead Protection Areas are delineated for the public supply wells, so the plume lies within a designated Wellhead Protection Area.

The limits of the Pandura Sierra Mountain Range run through the north and northeast region of Maunabo, in which the Pandura and El Sombrerito hills, at the border with Yabucoa, are the highest elevations. With the exception of the elevations noted above, the rest of the territory of Maunabo is quite level. As a result, it is geographically considered part of the Southern Coastal Valley.

2.2 Site History

Maunabo #1 was originally built in 1961 and used until 1974 (Adolphson et al. 1977). The well went back into service in 2001. Groundwater samples collected by the well system operator, PRASA, indicate that the chlorinated solvents, tetrachloroethylene (PCE), trichloroethylene (TCE), and cis-1,2-dichloroethylene (cis-1,2-DCE) have been detected in Maunabo #1 since March 2002. The maximum concentrations of PCE, TCE and cis-1,2-DCE detected in Maunabo #1 from 2002 to 2004 were 16.4 micrograms per liter (ug/L), 1.6 ug/L, and 4.3 ug/L, respectively. The MCL for PCE and TCE is 5 μg/L, and the MCL for cis-1,2-DCE is 70 μg/L. Another compound, 1,l-dichloroethylene (1,1-DCE) was detected in this well on an intermittent basis. Samples collected from the Maunabo #2, 3, and 4 wells over the same time period indicate that chlorinated solvents are generally not present in these wells. Table 2-1 shows PRASA water quality data from 1998 to 2004. Tap water samples of the distributed water show that the contaminants detected in Maunabo #1 had entered the drinking water system at various times.

In March 2002, the PRDOH ordered PRASA to close Maunabo #1 because the PCE concentration exceeded the federal MCL of 5 ug/L. However, rather than close this well, PRASA opted to treat the groundwater with carbon filtration tanks at the wellhead. Since then, the detections of PCE in raw groundwater samples from Maunabo #1 have exceeded the MCL. Post-treatment samples, including tap water samples collected along the distribution system downline from Maunabo #1, indicate that PRASA's treatment has not always been effective and that contaminated drinking water in this system is reaching the consumers. During an inspection in August 2004 PRDOH observed that the treatment cylinders at Maunabo #1 lacked the necessary filter medium (EPA 2006a).

2.2.1 Previous Investigations

Previous investigations have been conducted at the site to identify the source of the groundwater contamination. Investigations and activities were conducted by EPA.

2.2.1.1 Preliminary Assessment/Site Inspections, EPA

In October 2005, SAT 2 collected water samples from Maunabo Wells #1, #2, #3 and #4, and also in the distribution water line. The samples were analyzed for Target Compound List (TCL) volatile organic compounds (VOCs), base/neutral/acids (BNAs), pesticides/polychlorinated biphenyls (PCBs), and Target Analyte List (TAL) inorganic parameters including mercury and cyanide through the EPA Contract Laboratory Program (CLP). Data results are included in Appendix A. Sampling locations are shown in Figure 2-1.

The data confirmed the presence of PCE and cis-1,2-DCE in Maunabo #1 and in post-treatment samples along the distribution line at levels below MCL. The results also confirmed the presence of 1,1 DCE in Maunabo #4 and an unrelated compound, methyltertbutylether (MTBE), in Maunabo #1, as well as both compounds detected in the distribution samples. No detections were above MCL in this sampling event except for bis(2-ethylhexyl)phthalate in Maunabo #3 which was detected at 6.5 ug/L which is above the MCL of 6 ug/L. Maunabo #2 and Maunabo #3 show "non-detect" background concentrations for PCE; cis 1,2-DCE; 1,1-DCE and MTBE.

In December 2005, the SAT 2 conducted a limited investigation of possible sources of groundwater contamination in Maunabo. Facilities that were investigated include the former Maunabo Municipal Solid Waste Landfill (Maunabo Landfill), PRASA's

Wastewater Treatment Plant located close to Maunabo Well #1, El Negro Auto Body/Parts shop, Total Gas Station, Esso Gas Station, and five light industrial facilities operating under the auspices of the Puerto Rico Industrial Development Corporation (PRIDCO). The Maunabo Landfill is off Route 759, approximately 1.5 miles west of Maunabo #1. The location of the other facilities is shown in Figure 1-2.

The five PRIDCO industrial facilities are:

- Centro de Acopio Manufacturing (CAM) - CERCLIS ID No. PRN000205858
- Juan Orozco Limited, Inc. (JUA) - CERCLIS ID No. PRN000205861
- Puerto Rico Beverage (PRB) - CERCLIS ID No. PRN000205863
- FEMA Storage Facility (SF) - CERCLIS ID No. PRN000205860
- Plastic Home Products (PHP) - CERCLIS ID No. PRN000205862

A summary of SAT 2 field investigation activities and findings is presented below.

El Negro Auto Body/Parts Shop
SAT 2 conducted an on-site reconnaissance of the El Negro facility. The auto repair facility was observed to be in good condition and well maintained. One surface soil sample was collected from an open area adjacent to the facility (Figure 2-2). No subsurface or groundwater samples were collected by SAT 2 at this facility. The soil sample was analyzed for TCL VOCs under the EPA CLP. Sample analytical results indicated non-detect values for contaminants previously detected in the Maunabo public water supply wells as well as the remaining VOCs. SAT 2 has no detailed information regarding historical waste disposal practices at the site. The PA/SI report prepared by SAT 2 recommends no further remedial action for the El Negro facility (EPA 2006b). Table 2-2 shows a summary of the site samples collected. Data results are included in Appendix A.

Total Gas Station
SAT 2 collected two groundwater samples at the Total Gas Station (GS1) (Figure 2-3). Soil samples were not collected at this facility. The samples were analyzed for TCL VOCs under the EPA CLP. MTBE was detected at 14 and 7J ug/L in the groundwater samples collected at GS1. MTBE was also detected in Maunabo #1 which is downgradient from GS1, during the October 2005 sampling. Benzene was detected at GS1 at 4J and 20 ug/L, which is above the MCL of 5 ug/L. No PA/SI report was prepared by SAT 2 for this facility. Table 2-2 shows a summary of the site samples collected. Data results are included in Appendix A.

Centro de Acopio Manufacturing
SAT 2 collected four surface soil samples, two subsurface soil samples and one groundwater sample from open areas adjacent to the CAM facility building using Geoprobe™ direct-push method (Figure 2-4). The samples were analyzed for TCL VOCs under the EPA CLP. Sample analytical results indicated non-detect values for contaminants previously detected in the Maunabo public water supply wells as well as the remaining VOCs. A review of available background information indicates that these substances have not been generated by activities at the CAM site, nor were any

waste sources suspected of releasing or having the potential to release to groundwater or surface water identified at the CAM facility. The PA/SI report prepared by SAT 2 recommends no further remedial action for CAM (EPA 2006c). Table 2-2 shows a summary of the site samples collected. Data results are included in Appendix A.

Juan Orozco Limited, Inc.
SAT 2 collected four surface soil samples, three subsurface soil samples, including a duplicate sample, and one groundwater sample from open areas adjacent to the JUA facility building using Geoprobe™ direct-push method (Figure 2-5). The samples were analyzed for TCL VOCs under the EPA CLP. Sample analytical results indicated non-detect values for contaminants previously detected in the Maunabo public water supply wells as well as the remaining VOCs. A review of available background information indicates that these substances have not been generated by activities at the JUA site, nor were any waste sources suspected of releasing or having the potential to release to groundwater or surface water identified at the JUA facility. The PA/SI report prepared by SAT 2 recommends no further remedial action for JUA (EPA 2006d). Table 2-2 shows a summary of the site samples collected. Data results are included in Appendix A.

Puerto Rico Beverage
SAT 2 collected four surface soil samples, two subsurface soil samples, and one groundwater sample from open areas adjacent to the PRB facility building using Geoprobe™ direct-push method (Figure 2-6). The samples were analyzed for TCL VOCs under the EPA CLP. Sample analytical results indicated non-detect values for contaminants previously detected in the Maunabo public water supply wells as well as the remaining VOCs. A review of available background information indicates that these substances have not been generated by activities at the PRB site, nor were any waste sources suspected of releasing or having the potential to release to groundwater or surface water identified at the PRB facility. The PA/SI report prepared by SAT 2 recommends no further remedial action for PRB (EPA 2006e). Table 2-2 shows a summary of the site and samples collected. Data results are included in Appendix A.

FEMA Storage Facility
SAT 2 collected five surface soil samples, including a duplicate sample, and two subsurface soil samples from open areas adjacent to the FEMA Storage Facility using Geoprobe™ direct-push method (Figure 2-3). Groundwater was not encountered above bedrock, therefore, groundwater samples were not collected. The samples were analyzed for TCL VOCs under the EPA CLP. Sample analytical results indicated non-detect values for contaminants previously detected in the Maunabo public water supply wells as well as the remaining VOCs. Table 2-2 shows a summary of the site and samples collected. The FEMA Storage Facility was formerly operated by Caribe General Electric (CGE). Hazardous waste was generated by CGE during its operations. In addition, subsurface sand filters were reportedly removed from the site in 1987. The sand filters' location and former use is unknown. The PA/SI report prepared by SAT 2 recommends high priority for further action for FEMA Storage Facility due to hazardous waste generated at the site during CGE operations from an unknown date through 1995 (EPA 2006f). Data results are included in Appendix A.

Plastic Home Products

SAT 2 collected four surface soil samples and two subsurface soil samples from open areas adjacent to the PHP facility using Geoprobe™ direct-push method (Figure 2-7). Groundwater was not encountered above bedrock, therefore, groundwater samples were not collected. The samples were analyzed for TCL VOCs under the EPA CLP. Sample analytical results indicated non-detect values for contaminants previously detected in the Maunabo public water supply wells (i.e., PCE, TCE, DCE, and MTBE), as well as the remaining VOCs. A review of available background information indicates that these substances have not been generated by activities at the PHP site, nor were any waste sources suspected of releasing or having the potential to release to groundwater or surface water identified at the PHP facility. The PA/SI report prepared by SAT 2 recommends no further remedial action for PHP (EPA 2006g). Table 2-2 shows a summary of the site and samples collected. Data results are included in Appendix A.

Former Maunabo Landfill

SAT 2 collected four surface soil samples, including one duplicate, one subsurface soil sample and one groundwater sample at the former Maunabo Landfill (Figure 2-8). The samples were analyzed for TCL VOCs under the EPA CLP. Sample analytical results indicated non-detect values for contaminants previously detected in the Maunabo public water supply wells (i.e., PCE, TCE, DCE, and MTBE), as well as the remaining VOCs. No PA/SI report was prepared by SAT 2 for this facility. Table 2-2 shows a summary of site and samples collected. Data results are included in Appendix A.

PRASA Wastewater Treatment Plant

SAT collected four surface soil samples, two subsurface soil samples and one groundwater sample at the PRASA Wastewater Treatment Plant (Figure 2-8). The samples were analyzed for TCL VOCs under the EPA CLP. Sample analytical results indicated non-detect values for contaminants previously detected in the Maunabo public water supply wells as well as the remaining VOCs. No PA/SI report was prepared by SAT 2 for this facility. Table 2-2 shows a summary of the site samples collected. Data results are included in Appendix A.

Esso Gas Station

SAT 2 collected three groundwater samples, including one duplicate, at the Esso Gas Station (Figure 2-8). Soil samples were not collected at this facility. The samples were analyzed for TCL VOCs under the EPA CLP. Sample analytical results indicated non-detect values for contaminants previously detected in the Maunabo public water supply wells as well as the remaining VOCs. No PA/SI report was prepared by SAT 2 for this facility. Table 2-2 shows a summary of the site samples collected. Data results are included in Appendix A.

SAT 2 also collected four background surface soil, two background subsurface soil and one background groundwater sample (Figure 2-8). The samples were analyzed for TCL VOCs under the EPA CLP. Sample analytical results indicated non-detect values for contaminants previously detected in the Maunabo public water supply wells as well as the remaining VOCs. Table 2-2 shows a summary of the samples collected. Data results are included in Appendix A.

Based on the October and December 2005 data, there is insufficient information to determine conclusively the source of contamination of the local drinking water supply wells.

2.3 Current Conditions

The Maunabo site is comprised of a groundwater VOC plume identified by contamination found in public supply wells Maunabo #1 and Maunabo #4. During site visits in October 2006, CDM visited the four Maunabo public water supply wells and the sites investigated by SAT 2 in 2005 as potential sources. The four wells looked well maintained and in operation. Most facilities, including the former Maunabo Landfill, are currently active. The Centro de Acopio facility was closed at the time of CDM's visits. The Total Gas Station is abandoned and vacant. Tanks and other equipment were observed in the back of the Puerto Rico Beverage facility. A Dry Cleaner facility was identified during the site visit upgradient of Maunabo #1 near the Esso Gas Station.

Section 3
Site Setting and Initial Evaluation

This section presents an initial evaluation of site conditions, and is based on information obtained from previous investigations, published geological research documents, local and regional geological data, and data publicly available on the internet.

3.1 Review of Existing Data

This section summarizes the physical characteristics of the study area including the topography, drainage and surface water characteristics, regional and site-specific geology and hydrogeology, climate, population, and land use. Geological and hydrogeological data and publications pertaining to the Maunabo site were reviewed. Documents were obtained from the United States Geological Survey (USGS), EPA, municipal data, and internet sources.

3.1.1 Topography

The Maunabo site is located in southeastern Puerto Rico, within an isolated alluvial river valley (Figure 3-1). The site is surrounded by mountains to the north, east and west and the Caribbean Sea to the southeast. The highest point in the area is Cerro La Pandura at 1,700 feet amsl and the lowest point is the Caribbean Sea to the southeast. The Maunabo River and several intermittent streams are located in the site vicinity and flow southeast toward the Caribbean Sea.

The topography in the site vicinity slopes south to southwest from the nearby hills, approximately 180 feet amsl, toward the Maunabo River at 30 feet amsl (Figure 3-2). The elevation of the site area is approximately 40 feet amsl.

3.1.2 Drainage and Surface Water

The Maunabo site lies between the Quebrada Arenas to the east and the Maunabo River to the southwest. Most of the drainage across the site vicinity flows southwest, toward the Maunabo River (Figure 3-3). The drainage basin area of the Maunabo River is approximately 18 square miles and has its headwaters in Cerro LaTorresilla. The upper reach of the river flows steeply through igneous rock terrain then meanders through the alluvial valley until emptying into the Caribbean Sea. The average gradient through the igneous area is 230 feet/mile (ft/mi) while within the alluvial valley the gradient is 13 ft/mi (Adolphson et al 1977).

The estimated average discharge of the Maunabo River near the Maunabo site is 25 cubic feet per second (ft^3/s). The flow of the river is variable throughout the year, with the lowest flow occurring during the dry winter and spring months. Groundwater discharge forms the baseflow for the river which receives nearly 50 percent of its annual flow from the alluvial aquifer (Adolphson et al 1977). Groundwater also discharges to some of the smaller tributaries and streams (quebradas) such as Quebradas Arenas, Talante, de los Chinos, and Tumbada. These quebradas generally stop flowing during the late winter/early spring dry season.

3.1.3 Geological and Hydrogeological Characteristics

The geological and hydrogeological characteristics of the Maunabo area are described in the following sections. The hills surrounding the site are generally composed of igneous plutonic rocks such as granodiorite, diorite, and tonalite. The alluvial aquifer on which the site is located is a significant groundwater resource for the Maunabo area. The alluvial sediments are reported to be as thick as 200 feet and are underlain by the plutonic rocks (Adolphson et al 1977).

3.1.3.1 Regional and Site Geology

The Maunabo site is located within an alluvial valley surrounded by hills composed of igneous plutonic rocks. The two strata encountered at the site are the Quaternary-age alluvium deposits and the underlying Late Cretaceous-age igneous plutonic rocks mapped as the San Lorenzo Batholith on the USGS Punta Tuna/Yabucoa Quadrangle geologic map (Rogers et al 1979) (Figure 3-4). Tonalite outcrops of the Punta Guayanes Complex are located southwest and southeast of the site. Other units near the site but not anticipated to be encountered during field investigations are the metavolcanic rocks to the southwest and the small outcrops of metamorphic amphibole hornfels west and southeast of the site (Figure 3-4). The units expected to be found beneath and adjacent to the site are described below.

Quaternary Alluvium Deposits

The Quaternary alluvium deposits consist of unconsolidated silt, clay, sand, and gravel and underlie the Maunabo River valley (Figure 3-4). The lithology varies widely with numerous discontinuous lenses of clay, silt, and sand. The thickest and most permeable deposits are located within the buried ancestral bedrock valleys and can be up to 200 feet thick (Adolphson et al 1977). Figure 3-5 shows the estimated thickness of the alluvium in the Maunabo River Valley based on wells and test holes reviewed by Adolphson et al (1977).

The supply well drill logs from the PRASA well database were evaluated for lithology. The lithology of the alluvium at the Maunabo #2 (Bordaleza) supply well consisted of clayey sand to 15 feet, coarse brown sand with silt to 120 feet, weathered bedrock to 125 feet, and bedrock at 125 feet. At the Maunabo #3 supply well (Calzada), the lithology consisted of clay to 16 feet, clayey sand to 35 feet, coarse sand with gravel to 64 feet, sand to 76 feet and bedrock at 76 feet. At the Maunabo #4 supply well (San Pedro), the lithology consisted of clayey sand to 80 feet and brown clay to 90 feet and bedrock at 90 feet. No lithological information was available for the Maunabo #1 supply well.

The EPA SAT 2 Team performed soil and groundwater sampling at potential source areas in Maunabo. The soil and groundwater sampling logs show that at the upper PRIDCO facilities (FEMA Storage Facility and Plastic Home Products), bedrock was encountered at 20 to 22 feet bgs. No groundwater was encountered in this area. At the lower PRIDCO facilities (Centro de Acopio, Orozco, and PR Beverage) and the PRASA Wastewater Treatment Plant groundwater was encountered at between five and seven feet bgs and bedrock was not encountered (EPA 2006a). Soil samples in this

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area were described as dark brown sand with some silt to two feet bgs. Dark brown silty clay was reported to five feet bgs beneath the Orozco and PR Beverage facilities while a fine to coarse grained sand was reported at these depths beneath Centro de Acopio and the Wastewater Treatment Plant (EPA 2006a).

San Lorenzo Batholith

The San Lorenzo Batholtih, covering an area of 200 square miles is one of the most geologically prominent features in southeastern Puerto Rico. The batholith, formed during the Late Cretaceous Age, is composed of three major units, which in chronological order (oldest to youngest) include diorite and gabbro, the San Lorenzo granodiorite and tonalite, and the Punta Guayenes plutonic complex (Figure 3-4). The Punta Guayenes complex ranges from tonalite to quartz monzanite and is generally concentrated in the outer portion of the batholith (Rogers et al. 1979).

Structural Features

One prominent structural feature discussed by Adolphson et al. (1977) is an unnamed fault bisecting the Maunabo River valley. The fault strikes northwest to southeast with jointing perpendicular to the fault (Adophson et al. 1977) (Figure 3-3). The jointing causes the trellis-like drainage pattern in the area. Differential weathering along the joint planes causes the joint blocks to weather into subangular to well-rounded boulders (Adolphson et al. 1977). Rogers et al (1979), when mapping the geology of the Punta Tuna and Yabucoa areas, observed only tertiary faulting in the valley. They believe, however, that the noticeable lithologic break between the rocks to the north and south may represent a fault zone that existed during development of the San Lorenzo batholith in Late Cretaceous time but eventually healed (Roger et al. 1979).

3.1.3.2 Regional Hydrogeology

Groundwater is most abundant in the shallow unconfined alluvial aquifer of the Maunabo River valley. The underlying igneous putonic bedrock yields generally small to moderate quantities of water. Adolphson et al (1977) used information gathered from test holes, observation wells, irrigation wells, and public supply wells in the Maunabo River Valley to evaluate the hydrogeologic characteristics of the alluvium and bedrock aquifers. The hydraulic conductivity for the bedrock was estimated to be less than 1 foot per day while that for the alluvium ranged from 10 to 100 feet per day. The average transmissivity of the alluvial aquifer was estimated to be 4,000 square feet per day and the average specific capacity was 20 gallons per minute per foot of drawdown (Adolphson et al 1977). One round of synoptic water levels was taken of all available wells and test holes in the Maunabo River Valley. Groundwater flow within the alluvium was determined to be at an oblique angle toward the river in the direction of river flow (Figure 3-4) (Adolphson et al. 1977).

3.1.3.3 Site-Specific Hydrogeology

The Maunabo site consists of four PRASA supply wells and potential source areas in the center of Maunabo (Figure 1-2). The site is underlain by varying thicknesses of alluvium. The bedrock of the San Lorenzo Batholith underlies the alluvium. The aquifer of concern in the Maunabo area is the alluvial aquifer of the Maunabo River

Valley. Well data and logs obtained from PRASA and the USGS (EPA 2006a) indicate that active supply wells in the Maunabo area are completed in the alluvial sediments. The sediments are described in well logs as mainly clayey sand and some layers of coarse sand and gravel. Bedrock was encountered in three of the wells. The four wells range in total depth from 92 to 125 feet bgs while static groundwater level ranged from 4 to 17 feet bgs. The following is a brief description of each supply well:

- Maunabo #1 - The screened interval is 50 to 90 feet bgs, the borehole was drilled to 120 feet bgs and bedrock was not encountered.
- Maunabo #2 - The screened interval is 40 to 100 feet bgs, the borehole was drilled to 125 feet bgs and bedrock was encountered at the bottom of the borehole.
- Maunabo #3 - The screened interval is 24 to 84 feet bgs, the borehole was drilled to 100 feet bgs and bedrock was encountered at the bottom of the borehole.
- Maunabo #4 - The screened interval is 32 to 92 feet bgs, the borehole was drilled to 92 feet bgs and bedrock was encountered at the bottom of the borehole.

Groundwater flow within the site area may deviate slightly from the anticipated direction toward the Maunabo River due to the effects of pumping of the four supply wells at the site.

3.1.4 Climate

The climate for Maunabo, which is located in southeastern Puerto Rico, is classified as tropical humid and is moderated by the nearly constant trade winds that originate in the northeast. The average annual maximum and minimum temperature for the Maunabo area is 89.2° Fahrenheit (F) and 71.7° F, respectively. Precipitation data from 1971 to 2000 recorded at the Maunabo 66050 rainfall station shows an annual precipitation of 67.47 inches as reported on the Southeast Regional Climate Center website: <http://www.dnr.sc.gov/climate/sercc/ climateinfo/historical/ historical_pr.html>.

CDM will obtain both historical and current climate data, including, but not limited to, temperature, precipitation, and wind speed and direction, from local meteorological stations. Climatic data will be collected during the course of the field investigation and will be incorporated in the RI report.

3.1.5 Population, Land Use and Hazardous Waste Sites

The Maunabo site is located within the Maunabo Municipality in southeastern Puerto Rico. The Maunabo Municipality is comprised of 21 square miles with a population of 12,741 and a population density of 606.7 people per square mile (U.S. Census 2000).

The primary land use in the vicinity of the Maunabo site is agricultural with some residential, commercial, and light industrial development.

The population currently served by the four PRASA supply wells is 14,000 people (EPA 2006a).

Seven sites in the Maunabo site vicinity are listed in EPA's CERCLIS Hazardous Waste Sites database, and one site is listed in the Archived Sites database. Five of these sites are in the PRIDCO Facilities area as previously discussed in Section 2.2.1.1. The following is a list of these sites:

- Centro de Acopio Manufacturing (CAM) - CERCLIS ID No. PRN000205858
- Juan Orozco Limited, Inc. (JUA) - CERCLIS ID No. PRN000205861
- Plastic Home Products (PHP) - CERCLIS ID No. PRN000205862
- Puerto Rico Beverage (PRB) - CERCLIS ID No. PRN000205863
- FEMA Storage Facility (SF) - CERCLIS ID No. PRN000205860
- El Negro Auto Body/Part - CERCLIS ID No. PRN000205859
- Maunabo Urbano Public Wells - CERCLIS ID No. PRN000205831
- Former Maunabo Landfill - CERCLIS ID No. PRD980512420 (Archived)

No National Priority List (NPL) sites except the Maunabo site, are located within four miles of the Maunabo site.

3.1.6 Characteristics of Chemical Contaminants

The groundwater contamination is characterized by PCE, TCE, cis-1,2-DCE, 1,1-DCE, and MTBE levels above MCLs, as discussed in Section 2.2 of this work plan.

3.1.7 Conceptual Site Model

The Conceptual Site Model (CSM) was developed based on information collected such as previous investigations and geology, hydrogeology, and hydrologic investigations. It will be updated to integrate the different types of information collected during the remedial investigation, including geology, hydrogeology, site background and setting, and the fate and transport of contaminants associated with the site. The CSM will be updated as information is obtained during the RI. Figure 3-5 shows the current CSM for the Maunabo site.

Physical Setting with Respect to Groundwater Movement

The Maunabo site is located within an isolated alluvial river valley and is surrounded by mountains to the north, east and west and the Caribbean Sea to the southeast. The geology of the area is characterized by alluvial sediments as thick as 200 feet, underlain by bedrock. The predominant bedrock in the Maunabo area is the San Lorenzo Batholith, which consists of plutonic rocks such as granodiorite, tonalite, and quartz monzanite. The bedrock has little primary porosity; secondary porosity such as fractures is common. Public supply wells tap the alluvial aquifer and are up to 125 feet in depth. The water table in the alluvium is generally between 4 and 17 feet bgs. Groundwater flows toward the Maunabo River.

All of the groundwater in the Maunabo area is derived from precipitation. The volume of water that percolates down to the water table and recharges the groundwater is the residual of the total precipitation not returned to the atmosphere by evapo-transpiration or lost by runoff to the surface water drainage systems.

Potential Contaminant Sources

The site consists of a groundwater plume with no identified source(s) of the contamination. Groundwater sampling at the site detected PCE in the PRASA public supply wells at concentrations ranging from non-detect to 16.4 µg/L. Related chlorinated solvents, including 1,1-DCE, were also detected at 0.59 µg/L in Maunabo #4 during the October 2005 EPA SAT 2 sampling event.

EPA has identified 10 facilities as potential contaminant sources for the VOC groundwater contamination at the Maunabo site. The facilities are: Centro de Acopio Manufacturing, Juan Orozco Limited, Inc., Plastic Home Products, Puerto Rico Beverage, Storage Facility, El Negro Auto, Esso Gas Station, Total Gas Station, Maunabo Former Landifill and PRASA's Wastewater Treatment Plant located near Maunabo #1 public supply well (Figure 1-2 and Table 2-2).

In December 2005, EPA SAT 2 conducted a PA/SI at each of these facilities for potential VOC contamination in soils and/or groundwater. EPA's findings determined no VOC contamination in soils or groundwater in any of these facilities.

The FEMA Storage Facility was recommended for further investigation due to hazardous waster generated at the site during CGE operations. CGE used the facility from an unknown date through 1995 to manufacture high voltage contactors and resistors. Hazardous waste generated by CGE included lead-contaminated rags and debris, urethane foam resin, paint sludge, flammable waste, epoxy, paraffin solvent, and phosphoric acid. Samples collected by EPA at this facility were only analyzed for VOC, therefore, the presence of SVOCs and inorganics remains undetermined.

The Maunabo Landfill was investigated by EPA in the late 1980s. No CERCLA actions were deemed necessary at the site, therefore, the site was archived and the investigation closed in September 7, 1993.

Expected Transport and Fate of Site Contaminants

Groundwater

Liquid chlorinated solvents such as PCE and TCE, discharged to the ground surface would migrate downward through the unsaturated zone in a relatively linear pattern, with minimal dispersion from the discharge location. This will generally be the pattern when sand and gravel predominate beneath the source areas. In parts of the alluvium where clays are present beneath the potential source areas, migration of the liquid solvents could be complicated. Discharged solvents would migrate downward to the top of the clay unit, pool, then begin to migrate across the surface of the clay until a gap in the clay is encountered and then migrate through coarser sediments to the groundwater table. The unsaturated zone is approximately 4 to 17 feet thick in the Maunabo site area.

Once the liquid chlorinated solvents, such as PCE and TCE, encounter the water table, some of the solvent would dissolve into the groundwater and begin to move in the direction of groundwater flow toward the Maunabo River. If the quantity of solvent reaching the water table is sufficient, some of the solvent may remain in an undissolved state as a dense non-aqueous phase liquid (DNAPL). Since PCE and TCE are denser than water, the solvent would continue to move downward through sand and gravel sediments under the influence of gravity. DNAPL would sink until it encountered a lower permeability zone, such as a clay layer or the bedrock surface, which would slow or stop the downward migration. DNAPL could pool or accumulate on these low permeability zones and remain stationary. Chlorinated solvents such as PCE and TCE in a dissolved phase move with the groundwater flow, but generally at a slower rate than groundwater. The full extent of contamination in the aquifer is currently unknown.

Natural attenuation of chlorinated solvents is a documented process, with PCE breaking down through a known decay chain of compounds, with daughter products including TCE, cis-1,2-DCE and vinyl chloride (Vogel et al 1987). Breakdown of chlorinated solvents occurs most prominently under anaerobic conditions. It is currently unknown if the bedrock aquifer is aerobic or anaerobic.

Air

PCE and TCE are volatile organic chemicals. As such, they volatilize to the atmosphere and, in the unsaturated soil zone, to the pore spaces between soil particles. Volatile chemicals dissolved in groundwater also volatilize into the overlying unsaturated zone as a plume moves downgradient with the groundwater flow. Vapors move through the unsaturated zone pore spaces, often seeking preferential flow pathways such as sandier zones with more porosity and permeability, gravel commonly placed beneath concrete basements, or pipelines that may be backfilled with sandy material. As vapors move through the unsaturated zone, they can enter structures, such as homes, affecting air quality. Vapor movement may also be affected by differential pressure gradients, either natural (e.g., caused by weather changes) or man-made (e.g., pressure differences inside and outside structures).

Surface Water/Sediment

Groundwater may discharge into surface water bodies, including Rio Maunabo, and several other smaller streams. Therefore, the potential exists for contamination from the groundwater to affect the quality of surface water and/or sediments at (or downgradient from) the discharge points. The groundwater flow direction has not been adequately characterized at this time, but in the vicinity of the VOC impacted wells, it is expected to discharge into Rio Maunabo. Contaminated surface water and/or sediment could result in exposure to people utilizing the river or streams, or to ecological resources such as aquatic organisms or animals that frequent the habitat at the edge of water bodies. In addition, chemicals could enter the food chain, resulting in ecological exposure to higher levels of the food chain.

3.2 Preliminary Identification of Applicable or Relevant and Appropriate Requirements

This section provides a preliminary determination of the regulations that are applicable or relevant and appropriate to remediation of the groundwater at the Maunabo site. Both federal and Commonwealth environmental and public health requirements are considered. In addition, this section identifies federal and Commonwealth criteria, advisories, and guidances that could be used to evaluate remedial alternatives. Only those regulations that are considered relevant to the site are presented.

3.2.1 Definition of ARARs

The legal requirements that are relevant to the remediation of the site are identified and discussed using the framework and terminology of CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA). These acts specify that Superfund remedial actions must comply with the requirements and standards of both federal and Commonwealth environmental laws.

The EPA defines applicable requirements as "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or Commonwealth environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site". An applicable requirement must directly and fully address the situation at the site.

The EPA defines relevant and appropriate requirements as "those cleanup standards, standards of control, or other substantive requirements, criteria, or limitations promulgated under federal environmental or Commonwealth environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site".

Remedial actions must comply with Commonwealth ARARs that are more stringent than federal ARARs. Commonwealth ARARs are also used in the absence of a federal ARAR, or where a Commonwealth ARAR is broader in scope than the federal ARAR. In order to qualify as an ARAR, Commonwealth requirements must be promulgated and identified in a timely manner. Furthermore, for a Commonwealth requirement to be a potential ARAR it must be applicable to all remedial situations described in the requirement, not just CERCLA sites.

ARARs are not currently available for every chemical, location, or action that may be encountered. For example, there are currently no ARARs which specify clean-up levels for sediments. When ARARs are not available, remediation goals may be based upon other federal or Commonwealth criteria, advisories and guidance, or local ordinances. In the development of remedial action alternatives the information derived from these sources is termed "To Be Considered" (TBC) and the resulting requirements are referred to as TBCs. EPA guidance allows clean-up goals to be based upon non-promulgated criteria and advisories such as reference doses when ARARs do not exist, or when an ARAR alone would not be sufficiently protective in the given circumstance.

By contrast, there are six conditions under which compliance with ARARs may be waived. Remedial actions performed under Superfund authority must comply with ARARS except in the following circumstances: (1) the remedial action is an interim measure or a portion of the total remedy which will attain the standard upon completion; (2) compliance with the requirement could result in greater risk to human health and the environment than alternative options; (3) compliance is technically impractical from an engineering perspective; (4) the remedial action will attain an equivalent standard of performance; (5) the requirement has been promulgated by the Commonwealth, but has not been consistently applied in similar circumstances; or (6) the remedial action would disrupt fund balancing.

ARARs and TBCs are classified as chemical, action, or location specific. Descriptions of these classifications are provided below:

- Chemical-Specific ARARs or TBCs are usually health or risk-based numerical values, or methodologies which when applied to site specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment.

- Location-Specific ARARs or TBCs generally are restrictions imposed when remedial activities are performed in an environmentally sensitive area or special location. Some examples of special locations include flood plains, wetlands, historic places, and sensitive ecosystems or habitats.

- Action-Specific ARARs or TBCs are restrictions placed on particular treatment or disposal technologies. Examples of action-specific ARARs are effluent discharge limits and hazardous waste manifest requirements.

3.2.2 Preliminary Identification of ARARs and TBCs

The identification of ARARs occurs at various points during the RI/FS and throughout the remedial process. ARARs are used to determine the extent of cleanup, to scope and formulate remedial action alternatives, and to govern the implementation of the selected alternative.

The following are preliminary ARARs that may impact the selection of remedial alternatives for various environmental media at the site. This preliminary list of ARARs is based on current site knowledge and will be reviewed and updated during the RI/FS processes. Periodic review of the preliminary list of ARARs will assure that the ARARs remain applicable, as more site-specific information becomes available, and as new or revised ARARs are established.

3.2.2.1 Chemical-Specific ARARs

The determination of potential chemical-specific ARARs and TBCs for a site typically follows an examination of the nature and extent of contamination, potential migration pathways and release mechanisms for site contaminants, the presence of human receptor populations, and the likelihood that exposure to site contaminants will occur. The potential chemical-specific federal and Commonwealth ARARs for the site are as follows:

Federal:

- Resource Conservation and Recovery Act (RCRA) Groundwater Protection Standards and Maximum Concentration Limits (40 Code of Federal Regulations (CFR) 264, Subpart F)
- Clean Water Act, Water Quality Criteria (Section 304) (May 1, 1987 - Gold Book)
- Safe Drinking Water Act, Maximum Contaminant Levels (40 CFR 141.11-.16) issued July 1, 1991 and amended in the Federal Register 40 CFR Part 141 issued June 29, 1995. These levels include secondary MCLs, which are not enforceable but set standards for taste, odor, color, appearance, and other aesthetic factors that may affect public acceptance of water.

Commonwealth:

- Puerto Rico Water Quality Standards - Puerto Rico Environmental Quality Board (PREQB), Water Quality Standards Regulation, March 28, 2003)
- Puerto Rico Department of Health (PRDOH) National Primary Regulations of Potable Water, March 1992.
- PRDOH General Regulation for Environmental Health, Regulation No. 6090, February 4, 2000.

3.2.2.2 Location-Specific ARARs

The location of the site is a fundamental determinant of its impact of human health and the environment. Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in a specific location (EPA 1988). Some examples of these unique locations include: flood plains, wetlands, historic places, and sensitive ecosystems or habitats. The potentially applicable federal and Commonwealth location-specific ARARs for the site are as follows:

Federal:

- Executive Order on Wetlands Protection (CERCLA Wetlands Assessments) No. 11990
- National Historic Preservation Act (16 United States Code [USC] 470) Section 106 *et seq.* (36 CFR 800)
- Endangered Species Act of 1973 (16 USC 1531) (Generally, 50 CFR Part 402)
- RCRA Location Requirements for 100-year Flood Plains (40 CFR 264.18(b))
- Fish and Wildlife Coordination Act (16 USC 661 *et seq.*)
- Wetlands Construction and Management Procedures (40 CFR 6, Appendix A)
- Executive Order 11988, "Floodplain Management"
- Executive Order 11990, "Protection of Wetlands"
- 1985 Statement of Policy on Floodplains/Wetlands Assessments for CERCLA Action

Commonwealth:

- Puerto Rico EQB, Guidelines for Environmental Impact Statements
- Puerto Rico Department of Natural and Environmental Resources, Critical Element and Endangered Species Database, 1998

3.2.2.3 Action-Specific ARARs

Based on the identification of remedial response objectives and applicable general response actions, numerous federally promulgated action-specific ARARs and TBCs will affect the implementation of remedial measures and include administrative requirements related to treatment, storage and disposal actions.

The primary federal requirements which guide remediation are those established under CERCLA, as amended by SARA. The National Contingency Plan (NCP) incorporates the SARA Title III requirement that alternatives must satisfy ARARs and utilize technologies that will provide a permanent reduction in the toxicity, mobility or volume of wastes, to the extent practicable.

RCRA establishes both administrative (e.g., permitting, manifesting) requirements and substantive (i.e., design and operation) requirements for remedial actions. For all CERCLA actions conducted entirely onsite, only the substantive requirements apply. The potentially applicable federal and Commonwealth action-specific ARARs are as follows:

Federal:

- RCRA Subtitle C Hazardous Waste Treatment Facility Design and Operating Standards for Treatment and Disposal Systems, (i.e., landfill, incinerators, tanks, containers, etc.)(40 CFR 264 and 265) (Minimum Technology Requirements)
- RCRA Ground Water Monitoring and Protection Standards (40 CFR 264, Subpart F)
- RCRA Manifesting, Transport and Recordkeeping Requirements (40 CFR 262)
- RCRA Wastewater Treatment System Standards (40 CFR 264, Subpart X)

- RCRA Storage Requirements (40 CFR 264; 40 CFR 265, Subparts I and J)
- RCRA Subtitle D Nonhazardous Waste Management Standards (40 CFR 257)
- Toxic Substances Control Act (TSCA)(40 CFR 761)
- Clean Water Act - National Pollution Discharge Elimination System (NPDES) Permitting Requirements for Discharge of Treatment System Effluent (40 CFR 122-125)
- Clean Water Act Discharge to Publicly Owned Treatment Works (POTW) (40 CFR 403)
- National Emission Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR 61)
- Occupational Safety and Health Standards for Hazardous Responses and General Construction Activities (29 CFR 1904, 1910, 1926)
- Fish and Wildlife Coordination Act (16 UC 661 *et seq.*). (Requires actions to protect fish or wildlife when diverting, channeling or modifying a stream)
- National Primary and Secondary Ambient Air Quality Standards (40 CFR Part 50)
- The Endangered Species Act

Commonwealth:
- Puerto Rico General Requirements for Permitting Wells
- Puerto Rico EQB, regulation for the Control of Atmospheric Pollution, 1995
- Puerto Rico EQB, Regulation for the Control of Hazardous and Non-Hazardous Waste, 1982 as amended, 1985, 1986 and 1987
- Puerto Rico EQB, Underground Storage Tank Control Regulations, 1990
- Puerto Rico EQB, underground Injection Control Regulations, 1988

3.2.2.4 To Be Considered

When ARARs do not exist for a particular chemical or remedial activity, other criteria, advisories and guidance (TBCs) may be useful in designing and selecting a remedial alternative. The following criteria, advisories and guidance were developed by EPA, other federal agencies and Commonwealth agencies. The potentially applicable federal and Commonwealth TBCs are as follows:

Federal TBCs (Action, Location, and Chemical-Specific):
- Safe Drinking Water Act National Primary Drinking Water Regulations, Maximum Contaminant Level Goals (MCLGs)
- National Recommended Water Quality Criteria, EPA 2003
- Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario - Lowest Effect Level (LEL) and Severe Effects Level (SEL) (Ontario 1993)
- EPA Region 9 Preliminary Remediation Goals (PRGs), (EPA 2002)
- EPA Drinking Water Health Advisories
- TSCA Health Data
- Policy for the Development of Water-Quality-Based Permit Limitations for Toxic Pollutants (49 CFR 8711)
- Ground Water Classification Guidelines

- Ground Water Protection Strategy
- Fish and Wildlife Coordination Act Advisories
- Control of Air Emissions from Superfund Air Stripper at Superfund Groundwater Sites (OSWER Directive 9355.0-28)
- Draft Guidance for Evaluation of the Vapor Intrusion to Indoor Air Pathway, EPA 2002

Commonwealth TBCs (Action, Location, and Chemical-Specific):

- Puerto Rico EQB, Guidelines for Environmental Impact Statements
- PREQB, Soil Erosion Control and Sediment Prevention Regulation
- Puerto Rico EQB, Mixing Zone and Bioassay Guideline, 1988
- Puerto Rico Departmental of Natural and Environmental Resources, Critical Element and Endangered Species Database, 1998

Section 4
Work Plan Rationale

4.1 Data Quality Objectives

DQOs are qualitative and quantitative statements which specify the quality of data required to support decisions regarding remedial response activities. DQOs are based on the end uses of the data collected. The data quality and level of analytical documentation necessary for a given set of samples will vary, depending on the intended use of the data.

As part of the work plan scoping effort, site-specific remedial action objectives were developed. Sampling data will be required to evaluate whether or not remedial alternatives can meet the objectives. The intended uses of these data dictate the data confidence levels. The guidance document *Guidance for the Data Quality Objectives Process* (EPA 2000) was used to determine the appropriate analytical levels necessary to obtain the required confidence levels. The three levels are screening data with definitive level data confirmation, definitive level data, and field measurement-specific DQO requirements (Table 4-1).

The applicability of these levels of data will be further specified in the QAPP. Sampling and analytical data quality indicators (DQIs) such as precision, accuracy, representativeness, comparability, completeness, and sensitivity will also be defined in the QAPP.

4.2 Work Plan Approach

The HRS (EPA 2006a) indicates that the Maunabo Site consists of a contaminated groundwater plume without an identified source. VOC contamination has been detected in two PRASA public supply wells: Maunabo #1 and Maunabo #4. EPA's SAT 2 Team investigated 10 potential sources in the vicinity site. Soil and groundwater samples were collected from the potential source areas and analyzed for VOCs. Results of the sampling did not detect any of the chlorinated VOCs detected in the public supply wells. Because of the lack of an identified source or sources of groundwater contamination and based on discussions with EPA at the technical scoping meeting held on December 7, 2006, the technical approach developed in this work has two primary objectives:

- Define the nature and extent of contamination in site media including groundwater, surface water, and sediments
- Identify the source or sources of the groundwater contamination

This work plan defines the field investigation activities that will provide data to meet these primary objectives. The field investigation activities also will provide adequate data to support preparation of technical memoranda, an RI report, an HHRA, a SLERA, an FS and a Record of Decision (ROD). Both screening-level and definitive-level data will be used to support the objectives of this RI/FS.

4.2.1 Development of the Technical Approach

A review of previously collected data indicates that significant data gaps exist in the understanding of the nature and extent of groundwater contamination and contaminant sources at the Maunabo Site. Therefore the CSM, a significant element used to develop the field investigation, is very limited. CDM reviewed existing data provided by EPA's SAT 2 Team including the HRS (EPA 2006a) and preliminary assessment/site inspection reports, and background documents obtained from the USGS Caribbean Office, and other sources. Limited information exists concerning the nature and extent of groundwater contamination, potential contaminant sources, and hydrogeologic framework of the site. Specifically, the following major data gaps were identified:

- Source Areas - Information on contaminants present in potential source areas including industrial properties, gas stations, and a newly discovered potential source, the Maunabo Dry Cleaner facility
- Groundwater Flow - Lateral and vertical groundwater flow in the alluvium aquifer and in the bedrock near the northern end of the alluvial valley (FEMA Storage Facility and Plastic Home Products properties)
- Stratigraphy - Depth and stratigraphy of the alluvium aquifer in the Maunabo area
- Contamination - Nature and distribution of VOC contamination within the alluvium aquifer
- Pumping Effects - Effects of local pumping on groundwater flow
- Groundwater/Surface Water Interaction - Relationship between groundwater and surface water in the vicinity of the Rio Maunabo

A key consideration in developing the field investigation for the Maunabo Site is that a contaminant source has not been identified. EPA investigated potential source areas in the Maunabo area (EPA 2006a). EPA's SAT 2 Team conducted PA/SIs that included collection of soil and groundwater samples at 10 properties in the Maunabo area. No evidence of chlorinated VOCs, the contaminants detected in the Maunabo public supply wells, was detected in the soil or groundwater samples. MTBE, which was found in a groundwater sample taken from a well at the Total Gas Station, was also detected in the Maunabo No. 1 supply well. The hydrogeological investigation activities were designed to define the nature and extent of the chlorinated VOC plume and to provide data to support identification of potential source areas in the site vicinity.

The major elements of the field investigation for the Maunabo site include:

- A groundwater screening investigation including collection of soil samples at selected screening locations to obtain preliminary information on groundwater contamination, aquifer lithology and stratigraphy
- Installation of paired (shallow and deep) monitoring wells at locations selected based on the groundwater screening data

- Collection of samples for lithologic characterization and gamma logging of the deep well of each monitoring well pair
- Collection of two rounds of groundwater samples from monitoring wells and the Maunabo supply wells
- Synoptic water level measurements taken in conjunction with the two rounds of monitoring well sampling
- Long-term, continuous water level monitoring in selected monitoring wells
- Slug testing of shallow and deep wells
- Surface water, groundwater seepage, and sediment sampling in the Rio Maunabo
- Groundwater/surface water interaction study in the Rio Maunabo
- Source area subsurface soil sampling (Optional - this activity will be conducted only if a source is identified)
- Subslab vapor and indoor air sampling in selected residences and commercial establishments will be conducted only if shallow groundwater contamination is identified in a developed area

The groundwater screening program will provide preliminary information on the vertical and horizontal characteristics of the groundwater contamination. It will also provide additional information on potential groundwater contamination sources in the area. Monitoring well installation and sampling, and lithologic characterization of the aquifer will provide information on the geometry and lithology of the alluvium aquifer, groundwater flow, and confirm the boundaries of the groundwater contamination. The surface water and sediment investigation and the surface water/groundwater interaction study will provide data to evaluate potential impacts of the discharge of contaminated groundwater to the Rio Maunabo. Long-term water level monitoring and hydraulic testing will provide data to evaluate the effects of pumping on the aquifer and aquifer hydraulic characteristics, respectively.

CDM developed a technical approach and presented it to EPA in a technical scoping meeting held on December 7, 2006. The purpose of the technical scoping meeting was to present a preliminary technical approach and obtain input from EPA and stakeholders. A meeting minutes letter summarizing changes to the initial technical approach was prepared and submitted to EPA. Input from the technical scoping meeting is incorporated into this work plan.

CDM's technical approach includes elements from EPA's Triad approach guidance. The Triad approach is a conceptual and strategic framework that explicitly recognizes the scientific and technical complexities of site characterization, risk estimation, and treatment design. The groundwater screening program employs a dynamic sampling approach intended to focus the sample locations and sample depths on contaminated areas. Data from the previous day's samples will be used to make decisions about subsequent sampling locations and will refine the site's preliminary CSM as the investigation proceeds. Regular discussions will be held with the EPA remedial project manager (RPM) and technical staff regarding the progress of sampling and to modify sample locations and depths. This strategy will reduce cost by limiting the number of monitoring wells to those strictly necessary and will ensure placement of the wells at the appropriate location and depth.

4.2.2 Anticipated Laboratory Analyses

RAC II field team personnel will collect environmental samples in accordance with the rationale described in Section 5.3 of this work plan. All standard EPA sample collection and handling techniques will be utilized. Routine Analytical Service (RAS) samples will be analyzed in compliance with the Field and Analytical Services Teaming Advisory Committee (FASTAC) Policy. CDM will pursue the use of the CLP or DESA prior to using a laboratory subcontract and alternatives to standard CLP analysis will be sought with the EPA Regional Sample Control Coordinator (RSCC), prior to any sample collection activities and analyses via a subcontracted laboratory. Under the CLP "flexibility clause", modifications are often made to CLP SOWs, enabling achievement of method detection limits (MDL) that may meet the stated criteria.

CDM will implement the EPA Region 2 policy as shown below.

Tier 1:	Division of Environmental Science and Assessment (DESA) Laboratory (including Environmental Services Assistance Team (ESAT) support)
Tier 2:	EPA CLP
Tier 3:	Region specific analytical services contracts (use CLP flex clause)
Tier 4:	Obtaining analytical services using subcontractors via field contracts (such as RAC subcontractors)

All fixed laboratory analytical needs will to be submitted to the EPA RSCC regardless of the EPA or CLP laboratories' ability to perform the required analyses. CDM will utilize the RAC II basic ordering agreement (BOA) laboratories only in the event that the first three tiers are not available.

RAS CLP and DESA analytical results will be validated by EPA Region II. CDM will validate all subcontract laboratory data using the protocols specified in CDM's validation SOP which will be attached to the QAPP. CDM will then tabulate and evaluate the data and use it to characterize contamination at the site. All samples will be analyzed using the most current EPA-approved methods. Sampling procedures and specific analytical methods will be detailed in the site-specific QAPP.

The following sample analyses will be conducted.

- <u>Groundwater Screening Samples</u>: Low detection level (LDL) VOCs, with 24-hour turn-around for faxed results.

- <u>Surface Water and Groundwater Seepage Samples</u>: Surface water samples will be analyzed for trace level VOCs, TCL semi-volatile organic compounds (SVOCs), pesticides/PCBs, TAL metals, cyanide, hardness, alkalinity, ammonia, nitrate/nitrite, total Kjehldahl nitrogen (TKN), sulfate, sulfide, chloride, total organic carbon (TOC), total dissolved solids (TDS), and total suspended solids (TSS).

- **Sediment Samples**: Sediment samples will be analyzed for full TCL analytes including pesticides, and PCBs, TAL parameters, grain size, pH, and TOC.

- **Monitoring Well Samples**: Monitoring well samples will be analyzed for trace level VOCs, TCL SVOCs, pesticides/ PCBs, TAL metals, cyanide, chloride, methane, ethane, ethene, nitrate/nitrite, sulfate, sulfide, TOC, TSS, TDS, ammonia, alkalinity, hardness, and TKN. Ferrous iron analysis will be conducted onsite.

- **Soil Samples (Optional)**: Soil samples will be analyzed for full TCL analytes including pesticides and PCBs, TAL parameters, grain size (one-half of the samples), pH, and TOC.

- **Sub-Slab and Indoor Air Samples (Optional)**: Sub-slab and indoor air samples will be analyzed for selected VOCs based on groundwater screening and monitoring well data by the EPA Method TO-15 method by an EPA laboratory through the Flexibility Clause.

Section 5
Task Plans

The tasks identified in this section correspond to EPA's SOW for the Maunabo site, dated September 28, 2006. The tasks for the RI/FS presented below correspond to the applicable tasks presented in the *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 1988). In addition, EPA's SOW includes a task for project close-out. The task presentation order and numbering sequence correspond to the work breakdown structure provided in EPA's SOW.

5.1 Task 1 - Project Planning and Support

The project planning task generally involves several subtasks that must be performed in order to develop the plans and the corresponding schedule necessary to execute the RI/FS. These subtasks include project administration, conducting a site visit, performing a review and detailed analysis of existing data, attending technical scoping meetings with EPA and other support agencies, preparing this RI/FS work plan, preparing the QAPP and HSP, and procuring and managing subcontractors.

5.1.1 Project Administration

The project administration activity involves regular duties performed by the CDM site manager (SM) and the Program Support Office throughout the duration of this work assignment. CDM will provide the following project administration support in the performance of this work assignment.

The SM will:

- Prepare the technical monthly report
- Review weekly financial reports
- Review and update the project schedule
- Attend quarterly internal RAC II meetings
- Communicate regularly with the EPA RPM
- Prepare staffing plans

The Program Support Office personnel will:

- Review the work assignment technical and financial status
- Review the monthly progress report
- Provide technical resource management
- Review the work assignment budget
- Respond to questions from the EPA project officer (PO) and contracting officer (CO)
- Prepare and submit invoices

5.1.2 Attend Scoping Meeting

Following the receipt of this work assignment on September 28, 2006, the CDM RAC II technical operations manager (TOM) attended an initial scoping meeting with the EPA PO, and CO, in New York on October 5, 2006, to outline and discuss the project scope. The EPA RPM and CDM SM participated in the meeting via telephone. A Technical Scoping Meeting was held on December 7, 2006. The meeting was attended by CDM personnel, including the TOM, SM, RI Leader (RIL), senior scientist (SS) and risk assessor. EPA attendees included the PO, RPM, Project Hydrogeologist, Project Risk Assessors, and quality assurance/quality control (QA/QC) specialists.

5.1.3 Conduct Site Visit

The CDM SM, CDM RIL and EPA RPM conducted a site visit on October 12, 2006. CDM SM, TOM, and SS conducted a follow up site visit on October 25, 2006 to develop a better understanding of local and site-specific conditions. The site visits consisted of visual observation of site conditions, current use, and evaluating potential logistical and health and safety issues.

5.1.4 Develop Draft Work Plan and Associated Cost Estimate

CDM has prepared this RI/FS work plan in accordance with the contract terms and conditions. CDM used existing site data and information, information from EPA guidance documents (as appropriate) and technical direction provided by the EPA RPM as the basis for preparing this work plan.

This work plan includes a comprehensive description of project tasks, the procedures to accomplish them, project documentation, and a project schedule. CDM uses internal QA/QC systems and procedures to insure that the work plan and other deliverables are of professional quality requiring only minor revisions (to the extent that the scope is defined and is not modified). Specifically, the work plan includes the following:

- Identification of RI project elements including planning and activity reporting documentation, field sampling, and analysis activities. A detailed work breakdown structure of the RI corresponds to the work breakdown structure provided in the EPA SOW (dated September 28, 2006) and discussions with EPA.

- CDM's technical approach for each task to be performed, including a detailed description of each task, the assumptions used, any information to be produced during and at the conclusion of each task, and a description of the work products that will be submitted to EPA. Issues relating to management responsibilities, site access, site security, contingency procedures and storage and disposal of investigation derived wastes are also addressed. Information is presented in a sequence consistent with the SOW.

- A schedule with dates for completion of each required activity, critical path milestones and submission of each deliverable required by the SOW and the anticipated review time for EPA.

- A list of key contractor personnel supporting the project (Section 7) and the subcontractor services required for the work assignment.

CDM will prepare and submit a draft work plan budget (as Volume II of the RI/FS work plan) that follows the work breakdown structure in the SOW. The draft work plan budget contains a detailed cost breakdown, by subtask, of the direct labor costs, subcontractor costs, other direct costs, projected base fee and award fee, and any other specific cost elements required for performance of each of the subtasks included in the SOW. Other direct costs are broken down into individual cost categories as required for this work assignment, based on the specific cost categories negotiated under CDM's contract. A detailed rationale describing the assumptions for estimating the professional level of effort (PLOE), professional and technical levels and skills mix, subcontract amounts, and other direct costs are provided for each subtask in the SOW.

5.1.5 Negotiate and Revise Draft Work Plan/Budget

CDM personnel will attend a work plan negotiation meeting at EPA's direction. EPA and CDM personnel will discuss and agree upon the final technical approach and costs required to accomplish the tasks detailed in the work plan. CDM will submit a negotiated work plan and budget incorporating the agreements made in the negotiation meeting. The negotiated work plan budget will include a summary of the negotiations. CDM will submit the negotiated work plan and budget in both hard copy and electronic formats.

5.1.6 Evaluate Existing Data and Documents

As part of the preparation of the work plan, CDM reviewed data collected during previous investigations at the site. Analytical data and other information from these background documents were incorporated, where applicable, into this planning document. Existing data are summarized in Sections 2 and 3.

5.1.7 Quality Assurance Project Plan

CDM will prepare a QAPP in accordance with the Uniform Federal Policy (UFP) for QAPPs and current EPA Region II guidance and procedures. The QAPP will be submitted as a separate deliverable. The QAPP describes the project objectives and organization, functional activities, and QA/QC protocols that will be used to achieve the required DQOs. The DQOs will, at a minimum, reflect the use of analytical methods to identify and address contamination consistent with the levels for remedial action objectives identified in the NCP.

The QAPP includes sampling objectives; sample locations and frequency; sampling equipment and procedures; personnel and equipment decontamination procedures; sample handling and analysis; and a breakdown of samples to be analyzed through the CLP and through other sources, as well as the justification for those decisions. The QAPP is written so that a field sampling team unfamiliar with the site would be able to gather the samples and field measurements. Technical Standard Operating Procedures (SOPs) are included in the QAPP. Each SOP or QA/QC protocol has been prepared in accordance with EPA Region II guidelines and the site-specific HSP.

The QAPP also addresses site management, including site control and site operations. The site control section describes how approval to enter the areas of investigation will be obtained, along with the site security control measures, and the field office/command post for the field investigation. The logistics of all field investigation activities are described. The site operations section includes a project organization chart and delineates the responsibilities of key field and office team members. A schedule will be included that shows the proposed scheduling of each major field activity.

Any significant changes to the QAPP will require an amendment; minor changes will be documented on a Field Change Request Form and submitted in a letter to the EPA RPM and EPA QA officer.

Other Quality Assurance/Quality Control Activities
Quality assurance activities to be performed during the implementation of this work plan may also include internal office and field or laboratory technical systems audits, field planning meetings, and quality assurance reviews of all project plans, measurement reports, and subcontractor procurement packages. The quality assurance requirements are discussed further in Section 7.2 of this work plan.

5.1.8 Health and Safety Plan
CDM will prepare an HSP in accordance with 40 CFR 300.150 of the NCP and 29 CFR 1910.120 (1)(1) and (1)(2). The HSP includes the following site-specific information:

- Hazard assessment
- Training requirements
- Definition of exclusion, contaminant reduction, and other work zones
- Monitoring procedures for site operations
- Safety procedures
- Personal protective clothing and equipment requirements for various field operations
- Disposal and decontamination procedures
- Other sections required by EPA

The HSP also includes a contingency plan which addresses site specific conditions which may be encountered.

In addition to the preparation of the HSP, health and safety activities will be monitored throughout the field investigation. The HSP will specify air monitoring procedures in the exclusion zone established around the drilling rig or sampling locations. A qualified health and safety coordinator, or designated representative will attend the initial field planning meeting and may perform a site visit to ensure that all health and safety requirements are being adhered to. A member of the field team will be designated to serve as the onsite health and safety coordinator throughout the field program. This person will report directly to both the field team leader and the health and safety coordinator. The HSP will be subject to revision, as necessary, based on new information that is discovered during the field investigation.

5.1.9 Non-RAS Analyses
This subtask is not required for this work assignment. Non-RAS analyses are described in Section 5.4.3.

5.1.10 Meetings

CDM will participate in various meetings with EPA during the course of the work assignment. As directed by EPA's SOW, CDM has assumed eight meetings, with two people in attendance, for four hours per meeting. Six of these meetings will be held in Puerto Rico and two will be held in New York. CDM will prepare minutes which list the attendees and summarize the discussions in each meeting.

5.1.11 Subcontract Procurement

This subtask will include the procurement of all subcontractors required to complete the field investigation activities. Procurement activities include: preparing the technical statement of work; preparing Information for Bidders (IFB) or Request for Proposal (RFP) packages; conducting pre-bid site visits (when necessary); responding to technical and administrative questions from prospective bidders; performing technical and administrative evaluations of bid documents; performing the necessary background, reference, insurance, and financial checks; preparing consent packages for approval by the EPA CO (when necessary); and awarding the subcontract.

To support the proposed field activities, the following subcontractors will be procured:

- A licensed driller to drill groundwater screening borings, soil borings, install and develop monitoring wells, piezometers and staff gauges
- An analytical laboratory subcontractor to perform non-RAS analyses described in Section 5.4.3 and on Table 5-1
- A licensed surveyor to survey the location and elevation of all monitoring wells, piezometers, and staff gauges that will be installed during the RI/FS. Because the site area is large and the location of the source (s) is unknown, a detailed topographic map will not be produced for the site. The locations of sampling all points and monitoring wells will be displayed on ortho-rectified aerial photographs.
- A cultural resources subcontractor to conduct a Phase IA survey of the local area
- A subcontractor to haul and dispose of investigation derived waste (IDW), responsible for the removal and proper disposal of roll-off containers and storage tanks containing RI generated waste liquids and solids

All subcontractor procurement packages will be subject to CDM's technical and QA reviews.

5.1.12 Subcontract Management

The CDM SM and the CDM subcontracts managers will perform the necessary oversight of the subcontractors (identified under Section 5.1.11) needed to perform the RI/FS. CDM will institute procedures to monitor progress, and maintain systems and records to ensure that the work proceeds according to the subcontract and RAC II contract requirements.

CDM will review and approve subcontractor invoices and issue any necessary subcontract modifications.

5.1.13 Pathway Analysis Report

In accordance with OSWER Directive 9285.7-47 entitled *Risk Assessment Guidelines for Superfund - Part D* (2001a), CDM will provide EPA with standard tables, worksheets, and supporting information for the risk assessment as an interim deliverable prior to preparation of the baseline human health risk assessment report. CDM will prepare a Pathways Analysis Report (PAR) that consists of Risk Assessment Guidance for Superfund (RAGS) Part D Standard Tables 1 through 6 and supporting text. The PAR will summarize the key assumptions regarding potential receptors, exposure pathways, exposure variables, chemical distribution, and chemical toxicity values that will be used to estimate risk in the baseline human health risk assessment. Because RAGS Part D Tables 2 and 3 summarize site data, these tables of the PAR will be prepared after analytical data collected during the RI site investigation are available. Preparation of the PAR initiates the risk assessment process, whose components are described in greater detail in Section 5.7.1.

CDM will coordinate with EPA to define potential exposure pathways and human receptors. To accomplish this, CDM will review all available information obtained from EPA pertaining to the Maunabo site, including data generated during previous investigations. CDM will integrate this information with site data generated during the RI site investigation. Background information on the site will be summarized, and samples will be collected, and the data analyzed for various media will be discussed. The treatment of data sets (e.g., duplicates, splits, blanks [trip, field, and laboratory], multiple rounds, and qualified and rejected data) will be discussed, and chemical-specific exposure point concentrations (EPCs) for each exposure scenario will be determined. Based on current knowledge, potential receptors include residents (adults and children) using untreated private wells which draw on the contaminated groundwater of the aquifer. The receptors with the highest potential exposures are residents (adults and children) who use the groundwater as drinking water. Recreational users (both adults and children) of the Rio Maunabo will also be evaluated as potential receptors for exposure to the COPCs in sediment and surface water. Additional receptors may be identified as data are collected during the RI.

Exposure variables to be used for the calculation of daily intakes will be presented. Carcinogenic and noncarcinogenic toxicity values for chemicals of potential concern and the sources of these values will be presented in the PAR. The CDM risk assessor will coordinate with EPA, if necessary, to acquire toxicity values from NCEA for compounds that are not in Integrated Risk Information System (IRIS) or the Provisional Peer Reviewed Toxicity Values (PPPTV). As noted above, the selection of chemicals of potential concern, exposure pathways and receptors, exposure concentrations, exposure variables, and toxicity values will be summarized in tabular form in accordance with the Standard Tables of RAGS Part D.

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Upon EPA's approval of the PAR, CDM will evaluate potential exposures and risks associated with the site and initiate preparation of the draft baseline human health risk assessment report as described in Section 5.7.1.1.

5.2 Task 2 - Community Involvement

CDM will provide technical support to EPA during the performance of the following community involvement activities throughout the RI/FS in accordance with *Community Relations in Superfund-A Handbook* (EPA 1992b).

5.2.1 Community Interviews

CDM will perform the following activities:

- Preparation for Community Interviews - CDM will review background documents and provide technical and bilingual support to EPA in conducting community interviews with government officials (federal, Commonwealth, town, or city), environmental groups, local broadcast and print media, either in person or by telephone.
- Questions for Community Interviews - CDM will prepare draft interview questions in both Spanish and English for EPA's review. Final questions will reflect EPA's comments on the draft questions.

5.2.2 Community Involvement Plan

CDM will prepare a draft Community Involvement Plan (CIP) that presents an overview of community concerns. The CIP will include:

- Site background information including location, description, and history
- Community overview including a community profile, concerns, and involvement
- Community involvement objectives and planned activities, with a schedule for performance of activities
- Mailing list of contacts and interested parties
- Names and addresses of information repositories and public meeting facility locations
- List of acronyms
- Glossary

CDM will submit a Final CIP which reflects EPA's comments.

5.2.3 Public Meeting Support

CDM will perform the following activities in support of six public meetings and availability sessions.

- Make reservations for meeting space, in accordance with EPA's direction.
- Attend three public meetings and three availability sessions, and prepare draft and final meeting summaries.
- Reserve a court reporter for each of the three public meetings.

- Provide full-page and "four on one" page copy of meeting transcripts, both in hard copy and on a 3.5-inch diskette in Word Perfect 12 or latest version.

CDM will develop draft visual aids (i.e., transparencies, slides, and handouts) as instructed by EPA. CDM will develop final visual aids incorporating all EPA comments. For budgeting purposes, CDM will assume 35 slides and 75 handouts for each public meeting. The handouts will be prepared in English and Spanish.

5.2.4 Fact Sheet Preparation

CDM will prepare draft information letters/updates/fact sheets. CDM will research, write, edit, design, lay out, and photocopy the fact sheets. The fact sheets will be written in both English and Spanish. CDM will attach mailing labels to the fact sheets before delivering them to EPA from where they will be mailed. For budgeting purposes, CDM will assume three fact sheets (one for each public meeting), three to five pages in length, with four illustrations per fact sheet. CDM assumed 150 copies of each fact sheet will be provided to EPA. Final fact sheets will reflect EPA's comments.

5.2.5 Proposed Plan Support

CDM will provide administrative and technical support for the preparation of the draft and final Proposed Plan describing the preferred alternative and the alternatives evaluated in the FS. The Proposed Plan will be prepared in accordance with the NCP and the most recent version of *EPA Community Relations in Superfund - A Handbook* (EPA 1992b). The Proposed Plan will describe opportunities for public involvement in the ROD. The Proposed Plan will be written in English and Spanish.

A draft and final Proposed Plan will be prepared. The final will reflect EPA comments.

5.2.6 Public Notices

CDM will prepare newspaper announcements/public notices for each public meeting, for inclusion in the most widely read local newspapers, with each ad placed in two large area wide newspapers and a small town local newspaper. Three public announcements/notices will be prepared in both English and Spanish.

5.2.7 Information Repositories

In accordance with the SOW, this subtask is currently not applicable to this work assignment.

5.2.8 Site Mailing List

CDM will update the community relations mailing list two times for the Maunabo site. The mailing list will be developed under Subtask 5.2.2. and is estimated to consist of 130 names. CDM will provide EPA with a copy of the mailing list on diskette and mailing labels for each mailing. EPA will do the actual mailing of any information to the community.

5.2.9 Responsiveness Summary Support

CDM will provide administrative and technical support for the Maunabo site Responsiveness Summary. The draft document will be prepared by compiling and summarizing the public comments received during the public comment period on the Proposed Plan. CDM will prepare technical responses for selected public comments, for EPA review and use in preparing formal responses. CDM assumes 150 separate comments will be received and that 130 responses will be necessary.

5.3 Task 3 - Field Investigation

This task includes all activities related to implementing field investigations for the RI/FS for the Maunabo site. The task descriptions have been developed after review and evaluation of site background data currently available to CDM. Section 4.2 - Work Plan Approach - describes the technical approach to the field investigation, field investigation activities, media to be investigated, and anticipated laboratory analyses.

5.3.1 Site Reconnaissance

To complete this RI/FS work plan, CDM conducted an initial site visit to become familiar with local and site-specific conditions. CDM's SM and RIL conducted a reconnaissance of the site and surrounding area to evaluate logistical issues relevant to the groundwater screening program, monitoring well installation, and surface water and sediment sampling programs.

Additional site reconnaissance activities will be performed to support mobilization and to prepare for drilling and sampling activities. During the site reconnaissance, sampling locations will be identified and marked, property boundaries and utility rights-of-way will be located, utility mark outs will be completed by CDM's drilling subcontractor, and photographs will be taken. Site reconnaissance activities also include oversight of the cultural resources subcontractor and surveying subcontractor.

The following reconnaissance activities are also required to support the field activities:

- Identify and mark out groundwater screening locations
- Identify and mark out final locations for monitoring wells
- Identify and mark out stream sampling and groundwater/surface water interaction measurement locations
- Oversight of cultural resources survey
- Identify and mark soil source investigation boring locations (Optional)
- Identify sub-slab and vapor intrusion sampling in four residences or buildings (Optional)

A well survey of potential residential and commercial wells will be conducted during site reconnaissance activities. The survey will include a search of available databases and records and consultation with PRASA and municipal offices.

5.3.1.1 On-site Survey of Potential Source Areas

CDM will also conduct on-site surveys of potential source areas previously identified by

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EPA's SAT 2 Team and at a Dry Cleaner identified by CDM and EPA during the site visit. Although the PA/SI reports concluded no further response actions for most of the facilities, the data and historical information collected by SAT 2 is very limited. The on-site survey will collect additional information on these facilities which may help identify potential sources of VOC groundwater contamination.

The reconnaissance will include visual inspection of the interiors of the buildings and the exterior facility property for evidence of past and present disposal areas or discharge points (floor drains, discharge pipes, waste handling practices, etc.), discussions with current owners/operators, and search of PREQB records for additional historical information on site operations and waste disposal. On-site surveys will be conducted at the following properties:

- Five light industrial facilities currently owned by PRIDCO
  - Centro de Acopio Manufacturing
  - Juan Orozco Limited, Inc.
  - Puerto Rico Beverage
  - Plastic Home Products
  - FEMA Storage Facility
- PRASA Wastewater Treatment Plant
- El Negro Auto Body/Parts Shop
- Esso Gas Station
- Total Gas Station
- Maunabo Dry Cleaning

EPA will be responsible for obtaining access to the properties listed above.

Potential source areas, including small print shops and buildings across the Rio Maunabo from Maunabo Public Supply Well #1, will be investigated during site reconnaissance activities. Municipal records and officials will be consulted to determine if any print shops were located in Maunabo. The businesses across the Rio Maunabo will be evaluated by interviewing the owners and employees to determine the type of business operation that exists at each location.

5.3.1.2 Groundwater Screening/Monitoring Well Installation Reconnaissance

Prior to the groundwater screening and monitoring well drilling activities, the field team will visit proposed groundwater screening and monitoring well locations to identify exact locations and assess potential logistical issues and physical access constraints for the drill rigs. Prior to performing any drilling, CDM's drilling subcontractor will request a utility markout to identify the locations of underground utilities. CDM will verify that the utility markout was performed before drilling activities begin. Potential problem locations will be documented and photographed and locations may be adjusted to facilitate access.

5.3.1.3 Topographic Survey Oversight

A topographic map of the site will not be created since the site consists of a large area and a source area has not been identified. An ortho-rectified aerial photograph will be used as the base map for well and sample locations and figure development. Two surveying events are anticipated: The first survey event will occur immediately following the groundwater screening investigation and the second will occur after the monitoring wells are installed. It is anticipated that the locations and elevations of the groundwater screening points, surface water and sediment samples, groundwater/surface water interaction points, and stream staff gauge will be surveyed during the first surveying event. The location and elevation of monitoring wells will be surveyed during the second surveying event. Three elevations will be determined at each monitoring well: the ground surface, the top of the inner casing, and the top of the outer casing.

5.3.1.4 Surface Water and Sediment Sample Location Reconnaissance

Prior to conducting the surface water and sediment sampling and surface water/groundwater interaction study, the field team will visit proposed locations on the Rio Maunabo to assess potential logistical issues, safety issues, and physical access constraints. Potential problem locations will be documented and photographed and sampling locations may be adjusted based on the reconnaissance.

5.3.1.5 Cultural Resources Survey Oversight

The CDM cultural resources survey subcontractor will conduct a cultural resources survey covering the study area. The Stage 1A Cultural Resources Survey will be prepared in order to determine the presence or absence of cultural resources which may be impacted by the implementation of any remedial actions. The Stage IA survey is the initial level of survey and requires comprehensive documentary research and an initial walk-over reconnaissance and surface inspection. CDM will oversee the on-site activities of the cultural resources subcontractor.

5.3.2 Mobilization and Demobilization

This subtask will consist of property access assistance; field personnel orientation; field office and equipment mobilization and demobilization; and field supply ordering, staging, and transport to the site.

5.3.2.1 Site Access Support

Access to public areas and private property will be needed to execute the field investigation. EPA will be responsible for obtaining site access. CDM will assist EPA with site access. Significant access support is anticipated for the on-site surveys of potential source areas, groundwater screening investigation, monitoring well installation and sampling, vapor intrusion sampling, and source area soil sampling.

CDM will provide a list of property owners (public and private) to be accessed during the field activities. The list will include the mailing address and telephone number of the property owners. Once EPA has established that access has been granted, sampling activities can begin. CDM will contact and coordinate with property owners and local officials (for work in public areas) to schedule sampling activities.

5.3.2.2 Field Planning Meetings

Prior to performing the RI field activities, each field team member will review all project plans and participate in a field planning meeting conducted by the CDM SM and RIL to become familiar with the history of the site, health and safety requirements, field procedures, and QAPP. All new field personnel will receive a comparable briefing if they do not attend the initial field planning meeting and/or the tailgate kick-off meeting.

Supplemental meetings may be conducted as required by any changes in site conditions or to review field operation procedures.

5.3.2.3 Field Equipment and Supplies

Equipment and field supply mobilization will entail ordering, renting, and purchasing all equipment and supplies needed for each part of the RI field investigation. This will also include staging and transferring all equipment and supplies to and from the site. Measurement and Test Equipment forms will be completed for rental or purchase of equipment (instruments) that will be utilized to collect field measurements. The field equipment will be inspected for acceptability, and instruments calibrated as required prior to use. This task also involves the construction of a decontamination area for sampling equipment and personnel. A separate decontamination pad will be constructed by the drilling subcontractor for drilling equipment.

It is anticipated that one major mobilization will be required at the beginning of the field investigation and one major demobilization event will be required at the conclusion of the field investigation. A minor demobilization will occur at the conclusion of the groundwater screening investigation and a minor mobilization will occur prior to installation of the monitoring wells.

Field Trailer, Utilities, and Services

Arrangements for the lease of a field trailer and associated utilities (telephone, data line, and electricity), a secure storage area for IDW, trash containers, and portable sanitary facilities will be made. The command post area must be large enough to accommodate a 40-foot office trailer, two 20 cubic yard roll-off containers, one 10,000 gallon tank, portable sanitary facilities, a decontamination area, drilling equipment and supplies, drill rigs and subcontractor support vehicles, and CDM vehicles. EPA will assist with finding a suitable location for the command post area.

Health and safety work zones including personnel decontamination areas will be established. Local authorities such as the police and fire departments will be notified prior to the start of field activities. Equipment will be demobilized at the completion of each field event, as necessary. Demobilized equipment will include sampling equipment, drilling subcontractor equipment, health and safety equipment, and decontamination equipment.

5.3.2.4 Site Preparation and Restoration

Site Preparation

CDM will visually inspect drilling areas for the presence of overhead utilities and surface features that could limit the mobility or use of a drill rig at the proposed locations. The drilling subcontractor will be responsible for contacting an appropriate utility location service to locate and mark out underground utilities.

CDM plans to use existing roadway rights-of-way, open space, and clearings to the maximum extent possible to access sampling locations. However, it may be necessary to clear some areas of vegetation in order to access sampling locations. The drilling subcontractor will be responsible for clearing vegetation. CDM will direct and oversee any necessary clearing activities conducted by the drilling subcontractor.

Site Restoration
Field activities are expected to occur on private and public properties. In the event that properties are impacted by field activities, the property will be restored, as near as practicable, to the conditions existing immediately prior to such activities. CDM will maintain photographic documentation of site conditions prior to commencement of and after completion of RI field activities.

At the completion of the field activities, decontamination pad materials will be decontaminated and removed from the command post area. The decontamination and command post area will be restored, as near as practicable, to its original condition.

CDM personnel will perform field oversight and health and safety monitoring during site restoration field activities.

5.3.3 Hydrogeological Assessment

This section defines the objectives of the hydrogeological assessment and describes the hydrogeologic investigation activities that will be performed to identify potential source areas, define the nature and extent of groundwater contamination at the Maunabo Site, and support development of the CSM and hydrogeologic framework for the site. Section 4.2 - Work Plan Approach - describes the overall technical approach to the RI and the major elements of the field investigation.

Review of previously collected data indicates significant gaps in the understanding of the nature and extent of groundwater contamination and the hydrogeologic framework at the site. CDM reviewed existing information provided by EPA's SAT 2 Team which included PA/SI Reports for potential sources and groundwater sampling results for public supply wells. CDM also reviewed historical sampling data from the Maunabo public supply wells, and published geologic and hydrogeologic reports for the area.

There are significant gaps in information to support development of a detailed CSM, including groundwater flow direction, lithology and geometry of the unconsolidated sediments, aquifer properties, and interaction between groundwater and surface water near the Rio Maunabo.

Want data w/in 24 hours

The primary objectives of the hydrogeological assessment are to:

- Provide geologic, hydrogeologic, and contaminant distribution data to determine the nature and extent of groundwater contamination
- Refine the hydrogeologic aspects of the current CSM
- Obtain data on aquifer properties and groundwater flow
- Provide data on the groundwater/surface water interaction

In support of the primary objectives, the following hydrogeologic investigation activities will be performed at the site:

- Groundwater screening survey
- Monitoring well drilling and installation
- Gamma logging
- Synoptic water level measurements
- Groundwater/Surface Water Interaction Evaluation
- Aquifer testing
- Long-term groundwater level monitoring

5.3.3.1 Groundwater Screening Investigation

CDM's technical approach includes elements from EPA's Triad approach guidance. The groundwater screening program employs a dynamic sampling approach intended to focus the sample locations and sample depths on contaminated areas. Data from the previous day's samples will be used to make decisions about subsequent sampling locations and will refine the site's preliminary CSM as the investigation proceeds. Regular discussions will be held with the EPA remedial project manager (RPM) and technical staff regarding the progress of sampling and to modify sample locations and depths. This strategy will reduce cost by limiting the number of monitoring wells to those strictly necessary and will ensure placement of the wells at the appropriate location and depth. Groundwater screening will be performed to fill the data gaps described in Section 5.3.3. The objectives of the groundwater screening survey include:

- Estimate the vertical and lateral boundaries of groundwater contamination
- Provide basis for selection of monitoring well locations, depths, and screen intervals
- Provide preliminary information on lithology of the alluvium aquifer

Groundwater screening will be performed at up to 28 locations along four transects using the direct push technology (DPT) sampling method. Twenty four proposed groundwater screening locations are shown on Figure 5-1. Four contingency screening locations, not shown on Figure 5-1, are included to provide flexibility to collect additional groundwater screening samples to investigate potential source areas and to refine VOC concentrations between sampling locations or at the ends of transects. Groundwater screening at the contingency locations will be based on evaluation of the data from previous locations. The contingency screening locations will be approved by EPA before sampling begins.

The transects are generally oriented perpendicular to the estimated groundwater flow direction but access and physical constrains on the locations were also considered. Actual sampling locations will be based on the results of the on-site reconnaissance and will be confirmed with EPA prior to conducting the sampling.

Based on review of available geologic information, the affected Maunabo public supply wells are drilled to total depths of 80 to 125 feet. The alluvium is thin (approximately 20 feet thick) to the north of the valley, near the FEMA Storage Facility (EPA 2006a) and thickens to approximately 170 to 200 feet toward the south, near Maunabo #1 and the Rio Maunabo (Adolphson et al. 1977). The screened interval of Maunabo #1 is reportedly 50 to 90 feet bgs. The groundwater table is generally less than 10 feet bgs in the site area and, for estimating purposes, is assumed to be 10 feet bgs. The estimated total depth of the groundwater screening samples along Transect 1 (T-1), T-2, and T- 4 is 130 feet bgs. This depth is considered adequate based on the available information on the depths of the Maunabo public supply well screens. The total depth of screening samples along T-3 is estimated at 70 feet because the bedrock is shallower in that area. Table 5-2 summarizes the screening depths and number of samples that will be collected during the groundwater screening investigation. Fewer samples may be collected, depending on the results of the sampling.

It is assumed that all of the locations along T-1 and T-4 will be drilled and samples will be collected from all of the proposed depth intervals. For T-2 and T-3, VOC data from the previous day's sampling will be evaluated to aid in the determination of when to terminate sampling along the transect. Samples will be shipped on a daily basis to a laboratory for VOC analysis with a 24-hour turn-around time. Because of the low concentrations of VOCs detected in the public supply wells, sample quantitation limits for VOCs will be less than 1 ug/L. Groundwater samples will be analyzed by EPA method SOM01.0 or an equivalent method for trace level VOCs. With the exception of a few compounds, this method provided detection limits 0.5 ug/L.

To establish a profile of groundwater contamination, at each groundwater screening location, a DPT probe fitted with a screen will be driven to the target depth. A groundwater screening sample will collected at the terminal depth. Sampling will proceed upward, toward the ground surface, from the terminal depth. Groundwater samples will be collected at 10-feet intervals at all of the screening points. The final sample will be collected at a depth of two feet below the groundwater surface.

A peristaltic pump and polyethylene tubing will be used to purge the well point. The DPT rods will be purged to clear the screen of fines and to produce as clear a sample as possible. Each sampling interval will be purged before it is sampled to ensure that the groundwater is representative of the sampled interval. Purge water will be monitored for pH, conductivity, temperature, dissolved oxygen, and turbidity. Once the monitoring parameters have stabilized samples will be collected using polyethylene tubing fitted with a check valve.

Samples will be shipped to a fixed-base laboratory for low concentration VOC analysis on a 24-hour turnaround basis. Laboratory services will be obtained using EPA's FASTAC strategy as described in Section 4.2.

The CDM SM and RI field task manager will hold daily discussions with the EPA RPM and hydrogeologist to evaluate sample analytical data and to determine when to terminate sampling. Based on a review of the VOC data and discussions with EPA, sample locations and/or sample depths may be modified or sample locations may be deleted. Any such modifications will be approved by the EPA RPM.

Limitation of the DPT Drilling Method

The 130-foot screening depth is near the limit of the direct push technology. If site conditions are such that it is not possible to reach the target depths, then alternate drilling and sampling method will be considered. Any such change will be approved by EPA. A description of the alternate drilling and sampling method is provided below.

Hollow stem auger (HSA) is the proposed alternate drilling method if the target screening depth (130 feet bgs) cannot be reached using DPT. This method will only be used for the screening intervals that can not be reached using the DPT. Groundwater samples will be collected using a Hydropunch or equivalent technology, deployed inside the HSA. HSA will be used to drill to the target depth and the Hydropunch sampler will be driven below the bottom of the augers. The Hydropunch will be purged to clear the screen of fines and obtain a sample representative of the interval. Purge water will be monitored for pH, conductivity, temperature, dissolved oxygen, and turbidity. Once the monitoring parameters have stabilized samples will be collected using polyethylene tubing fitted with a check valve. Following collection of the sample the HSA will be advanced to the next interval and the Hydropunch will be driven ahead of the augers and interval purged and sampled. The process will be repeated until the target depth for the location is reached. Samples will be analyzed for the same parameters as samples collected using the DPT method.

Letter Report and Meeting with EPA

At the conclusion of the groundwater screening program, CDM will prepare a letter report summarizing and evaluating the groundwater screening data and proposing locations and depths for permanent monitoring wells. CDM will attend a meeting with EPA to obtain input on and finalize the locations of the proposed monitoring well locations. Following the meeting with EPA, CDM will prepare and submit meeting minutes summarizing the conclusions of the meeting.

5.3.3.2 Lithologic Sampling and Logging

Subsurface soil samples will be collected at eight groundwater screening locations to provide lithological information to enhance the CSM and to support selection of permanent monitoring well locations and construction materials. The soil samples will be collected after the groundwater screening is completed. The soil samples will not be submitted for chemical analysis. The proposed locations for lithologic sampling and logging are shown on Figure 5-1.

At each lithologic sampling location, 4-foot core samples will be collected at 10-foot intervals using DPT, starting at the surface and proceeding to the terminal depth of the boring; 130 feet for T-1, T-2 and T-4 locations and 70 feet for T-3 locations. Three locations along the T-1 transect, two locations along the T-2 and T-3 transects, and one location at T-4 transect will be selected for lithologic sampling and logging. A total of 100 samples will be collected for lithologic logging: 84 samples from the T-1, T-2 and T-4 locations and 16 from the T-3 locations. Lithologic logging will be performed by the on-site geologist and recorded in the field log book. Lithologic sampling and logging procedures will be detailed in the QAPP.

5.3.3.3 Monitoring Well Drilling and Installation

This section describes the monitoring well drilling and installation activities that will be performed to support the RI/FS. Monitoring wells will be installed following completion of the groundwater screening survey is complete.

The primary objectives of the monitoring well installation and sampling are to:

- Define the nature and extent of groundwater contamination
- Collect lithologic and stratigraphic data to refine the CSM
- Provide wells for aquifer testing
- Provide a means to monitor temporal changes in contaminant distribution

Sixteen monitoring wells will be installed in the alluvium aquifer and three monitoring wells will be installed in the bedrock. Bedrock wells will be installed at the FEMA Storage Facility. The PA/SI conducted for this facility indicated that groundwater was not present above the bedrock surface.

<u>Alluvium Aquifer Monitoring Wells</u>

A total of 16 monitoring wells at 8 locations are proposed, including one background well location. Figure 5-2 shows the locations of monitoring wells. However, monitoring well locations and depths may be modified based on evaluation of the groundwater screening survey data.

For cost estimation purposes, it is assumed that wells will be installed in pairs consisting of a deep and a shallow well. This will provide a means to define the vertical boundaries of groundwater contamination. Due to the varying depth of the alluvium aquifer, it is estimated that six shallow wells will be drilled to a depth of 50 feet bgs and that two shallow wells will be drilled to a depth of 30 feet bgs. Six deep wells will be drilled to a depth of 90 feet bgs and two deep wells will be drilled to a depth of 70 feet bgs.

It is anticipated that monitoring wells will be installed using the HSA drilling method. Eight-inch diameter boreholes will be drilled to the target depth. Monitoring wells will be constructed of 4-inch diameter Schedule 40 polyvinyl chloride (PVC) casing and 10 foot lengths of slotted PVC screen. It is assumed that wells in the alluvium will be single-cased, although, if a significant clay layer is found to separate the shallow aquifer zone from the deep aquifer zone, double casing will be used. EPA will be consulted about this issue and a Field Change Request will be submitted. Any additional costs will be outlined in a work plan letter and submitted to EPA. The annulus around the well screen will be backfilled with sand which will extend 2-feet above the well screen. A 2-foot bentonite seal will be placed above the sand pack and the remaining annulus will be grouted to the surface. An 8-inch steel protective casing with a locking cap will be installed and a concrete collar will be poured around the well. The well screen slot size and the grade of filter sand will be determined based on the results of the lithologic sampling of the groundwater screening locations. Well drilling and construction details will be specified in the site-specific QAPP.

Split-spoon samples will be collected at 5-foot intervals from the surface to total depth in the deep well of the each well pair. The split spoon samples will be logged by the on site geologist. The lithologic information will be used to support development of the hydrogeologic framework and CSM for the site. It is important to identify the presence of significant clay layers, sand and gravel layers, and other geologic materials that may control or limit groundwater flow and contaminant transport in the aquifer. Split-spoon samples will be screened with a photoionization detector (PID) to identify contaminated zones within the borehole. The PID screening data will be used to refine placement of the well screen.

<u>Bedrock Monitoring Wells</u>

Three monitoring wells will be drilled into bedrock; one upgradient of the FEMA Storage Facility and two downgradient (Figure 5-2). It is anticipated that one bedrock monitoring well will be cored. The cored well will be drilled first and logged to identify potential water bearing zones in the bedrock. The three bedrock wells will be installed approximately 30 feet into the bedrock or a total depth of approximately 60 feet bgs. Air rotary drilling will be used to drill through the unconsolidated materials and at least five feet into competent bedrock.

<u>Air Rotary Well Drilling</u>

The unconsolidated soil portion of the borehole will be advanced from the ground surface to the bedrock using an air rotary drilling method to create a 12-inch diameter borehole. A 8-inch diameter carbon steel casing will be tightly sealed into competent bedrock surface using a cement/bentonite grout slurry. Upon installation of the outer steel casing, the core will be drilled (see below). After coring the borehole will be advanced through the bedrock using the air rotary with direct circulation drilling method to create a nominal 8-inch borehole. The on-site geologist will monitor and record the materials brought to the surface by the air rotary drilling methods.

<u>Rock Coring Well Drilling</u>

An NX rock coring bit will be used to advance a nominal 3-inch diameter borehole to depth. Upon completion of the coring, the borehole will be reamed to provide a nominal 8-inch diameter borehole. The on-site geologist will log the rock core, place the core in a core box, and store the core box for future reference. The rock cores will either be transferred to a government archive or disposed of by the IDW subcontractor at the completion of the work assignment.

Bedrock Monitoring Well Installation

Upon completion of the borehole to the target depth, the well will be installed. The bedrock boreholes will be double cased. Monitoring wells will be constructed of 4-inch diameter Schedule 40 PVC casing and 10-foot lengths of 0.10-inch slotted PVC screen. The annulus around the well screen will be backfilled with sand which will extend 2-feet above the well screen. A 2-foot bentonite seal will be placed above the sand pack and the remaining annulus will be grouted to the surface with cement/bentonite grout. A 10-inch steel protective casing with a locking cap will be installed and a concrete collar will be poured around the well. Well drilling and construction details will be specified in the site-specific QAPP.

Monitoring Well Development

Monitoring well installation will not be considered complete until the wells have been fully developed. Monitoring well development will be performed to remove silt and well construction materials from the well and sand pack and to provide a good hydraulic connection between the well and the aquifer materials. Turbidity, pH, temperature, conductivity, and dissolved oxygen will be monitored during development. Development will continue until all parameters have stabilized (within 10 percent for successive measurements) and the water is clear. Well development procedures will be detailed in the site-specific QAPP.

IDW Management

Drill cuttings and water from drilling operations will be containerized at the drilling location and transported by the drilling subcontractor to a central waste storage area. Liquid wastes will be transferred to a 21,000 gallon Baker tank and drill cuttings will be transferred to 20 cubic yard roll-off containers for subsequent sampling, characterization, and disposal by CDM's IDW subcontractor.

5.3.3.4 Synoptic Water Level Measurements

Two rounds of synoptic water level elevation measurements will be taken in the 19 newly installed wells to define groundwater flow at the site. The synoptic groundwater level measurements will be taken in conjunction with the two rounds of groundwater sampling. Groundwater contour maps will be constructed for each of the shallow and deep groundwater monitoring zones, and will be included in the RI/FS reports.

Before taking water level measurements, each well's location and elevation will be determined by a licensed land surveyor. Elevation measurements will be made at marked water level measuring points on the inner casing, the top of outer protective casing, and the adjacent ground surface. The wells will be allowed to equilibrate after development for a minimum of two weeks before water level measurements are taken.

5.3.3.5 Natural Gamma Logging

Once well construction is complete, natural gamma logs will be run in the deep well of each monitoring well pair and the three bedrock monitoring wells. Gamma logs will assist with identification of clay layers in the overburden. Gamma logging will be

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performed by CDM personnel. Results of the gamma logging will be correlated with lithologic logs. Geophysical logging procedures will be fully detailed in the QAPP.

5.3.3.6 Groundwater/Surface Water Interaction Investigation

The groundwater/surface water interaction will be evaluated in the Rio Maunabo. A staff gauge and five temporary drive-point piezometers will be installed in the streambed of the Rio Maunabo. The locations of the temporary piezometers are shown in Figure 5-3.

The temporary piezometers will consist of a drive-point screen 6 to 12-inches in length attached of stainless steel pipe. The screen will be driven 3 to 4 feet into the streambed. At each location, water measurements will be taken of the water level inside the piezometer and the water level of the stream. Both measurements will be referenced to the same location at the top of the piezometer. The elevation and location of the top of each piezometer will be surveyed.

The staff gauge will consist of a calibrated scale affixed to a steel rod driven into the streambed. The top of the staff gauge will be surveyed so that water level measurements can be referenced to a known datum. The temporary piezometers and staff gauge will be installed at locations that are accessible by wading. A detailed description of the groundwater/surface water interaction investigation will be provided in the site-specific QAPP.

5.3.3.7 Aquifer Testing

Several types of aquifer tests could be performed at the site, including long-term (e.g., 24-hour to 72-hour) pumping at a selected monitoring well or specially installed well, limited pumping (e.g., 4 hours) at one or more selected monitoring wells, or slug tests in the screen intervals of selected monitoring wells. After discussions with EPA on the advantages and disadvantages of each type of test, EPA determined that slug tests should be performed, with a contingency to perform a limited (i.e., 24-hour) pump test using Maunabo #1 public supply well as a pumping well. Use of Maunabo #1 as the pumping well will require coordination with PRASA to maintain a constant pumping rate over the period of the test. Since observation wells are not located close to Maunabo #1, it is likely that piezometers will need to be installed near Maunabo #1 to provide a means to observe drawdown in the aquifer during the test. Since the use of Maunabo #1 is uncertain, no costs are provided to conduct the 24-hour constant rate pump test. CDM will contact PRASA and determine if it is feasible to use Maunabo #1 as the pumping well for the aquifer test. If PRASA supports the use of Maunabo #1 and agrees to maintain an appropriate pumping rate for 24-hours, CDM will prepare a cost estimate for the following activities:

- Estimate the locations of the piezometers based on pumping rates and aquifer hydraulic conductivity (using literature values)
- Install piezometers in the vicinity of Maunabo #1
- Conduct the constant rate aquifer test
- Evaluate the aquifer test data

CDM will submit a work plan letter to EPA, detailing the estimated costs to conduct the aquifer test.

Slug tests will be conducted at selected monitoring wells that cover a range of depths, lithology types, and locations across the site. For cost estimation purposes, it is assumed that half of the 19 wells will be slug tested. Slug tests are a rapid and easy means to estimate hydraulic conductivity of an aquifer. Advantages of slug tests over pump tests include the fact that little or no contaminated water is produced, which then requires containment, sampling, and disposal as IDW or treatment at the pump test site prior to disposal. Disadvantages include that the hydraulic conductivity estimates are limited to a small volume of the aquifer around the borehole; slug tests may only measure the hydraulic conductivity of the sand pack around the well screen; or extrapolating the results from one well to other areas or intervals of the aquifer may be questionable.

Slug tests are conducted by adding (or removing/displacing) a known volume to (or from) the monitoring well to create a rapid rise (or fall) in water level. Water levels are measured as the water in the well returns to static (pre-test) conditions. Water is displaced with a weighted cylinder of known volume. The rate of water recovery is measured with a pressure transducer and data recorder. Both rising and falling head slug tests will be conducted. Slug test procedures will be fully detailed in the QAPP.

5.3.3.8 Long-Term Water Level Monitoring

The overall objective of the long-term water level monitoring program is to collect data to evaluate temporal fluctuations in water levels in the vicinity of the affected municipal supply wells in response to precipitation and local pumping. The data will also be used to support the CSM and in the evaluation of groundwater flow. Long-term groundwater level monitoring will conducted in four shallow and four deep monitoring wells and will occur over a period of four weeks. Data will be collected using in-situ water level monitoring instruments capable of storing water level data for the duration of the test and equipped with barometric pressure compensation (Level Troll or equivalent). To provide baseline water levels and to verify the water level measurements, manual water levels will be collected at the start of monitoring; at weekly intervals during monitoring; and at the conclusion of the monitoring. To ensure that the instruments are operating properly, monitoring instruments will be checked on a weekly basis and the data downloaded and checked. At the end of the monitoring period, the data will be downloaded and stored for evaluation. To evaluate precipitation effects on water levels, precipitation data for the monitoring period will be obtained from a local weather station.

Before initiating water level measurements, each well's location and elevation will be determined by a licensed land surveyor under subcontract to CDM. Elevation measurements will be made at marked water level measuring points on the steel casing and on the adjacent ground surface.

5.3.4 Soil Boring, Drilling, and Testing (Optional)

This section describes soil boring, drilling, and testing activities that will be performed as part of the RI investigation. The overall objective of the soil sampling is to characterize the surface and subsurface at a potential source area.

Surface and subsurface soil sampling in a source area or areas is contingent upon the results of the other activities proposed in the work plan, therefore will only be conducted if the on-site survey or the groundwater investigation activities identify a likely contaminant source or sources. CDM will notify EPA if a potential source area is located. Any subsurface soil sampling activities will be approved by EPA.

5.3.4.1 Source Area Soil Investigation (Optional)

For cost estimating purposes, it is assumed that one source area will be investigated and surface and subsurface soil samples will be collected at 10 locations in the vicinity of the source. One surface soil sample (0 to 2 feet bgs) will be collected at each of the 10 soil boring locations. Subsurface soil samples will be collected until the groundwater table is reached using a DPT rig. One sample will be collected from the 2-4 foot interval and then one sample per four-foot interval thereafter (4-8 and 8-12 feet) based on visual observations and PID readings. It is estimated that up to three cores will be collected from each location. One soil sample will be collected from each 4-foot core for a total of 30 subsurface soil samples.

Upon retrieval from the drill rod each 4-foot core will be screened for VOCs using a PID. The onsite geologist will select the interval for analysis using the PID readings together with visual observations of any potential source materials. If significant contamination is identified in other depth intervals by either visual observation or PID readings, additional samples may be collected and documented in a Field Change Request Form.

The lithology of each sample will be characterized and logged by the field geologist. Depth to groundwater, if encountered, and PID readings also will be recorded in the log. To prevent cross-contamination, drill rods will be decontaminated between successive locations and new, polyethylene sleeves will be used for each sample.

Surface and subsurface soil samples will be analyzed for full TCL/TAL Twenty percent of the samples will be analyzed for pH, TOC and grain size. Detailed sample collection and decontamination procedures will be provided in the QAPP.

5.3.5 Environmental Sampling

Table 5-1 summarizes the number of samples and associated analytical parameters for the various environmental media that will be sampled during the RI. The CDM Regional Quality Assurance Coordinator (RQAC) will ensure the laboratory meets all EPA requirements for laboratory services. QC samples will be collected in addition to the environmental samples discussed below. The number and type of QC samples will be in accordance with the EPA Region II CERCLA QA Manual.

5.3.5.1 Monitoring Well Sampling

Groundwater samples will be collected at the Maunabo site to characterize the nature and extent of contamination in groundwater from contaminants associated with the site. Analytical data from groundwater sampling will be used to support preparation of the RI, HHRA, and FS reports.

Two rounds of groundwater samples will be collected from the 19 monitoring wells installed during the RI and the four Maunabo public supply wells. A total of 46 groundwater samples will be collected; 23 samples during each round. A minimum of two weeks will elapse between well development and groundwater sample collection. A minimum of three months will elapse between Round 1 and Round 2. Synoptic water level measurements will be collected from all monitoring wells prior to sampling, as described in Section 5.3.3.4. Monitoring wells will be purged with a Grundfos Rediflo 2 submersible pump and sampled following the site-specific low-flow, minimal drawdown sampling procedure which follow the EPA SOP *Ground Water Sampling Procedure, Low Stress (Low Flow) Purging and Sampling* (EPA 1998c). Groundwater sampling procedures will be fully detailed in the site-specific QAPP.

Groundwater samples will be analyzed for trace level VOCs, TCL SVOCs, pesticides/PCBs, and TAL inorganics. To support evaluation of natural attenuation of VOCs in groundwater, samples will be analyzed for the following parameters: chloride, methane, ethane, ethene, nitrate/nitrite, sulfate, sulfide, and TOC. Samples will also be analyzed for water quality parameters including TSS, TDS, alkalinity, ammonia, hardness, and TKN. Dissolved oxygen (DO), oxidation reduction potential (as Eh), turbidity, pH, temperature, ferrous iron, and conductivity will be measured in the field. A flow-through cell will be used when measuring oxygen-sensitive field parameters.

CDM will review the results of the Round 1 groundwater samples for detections of SVOCs, pesticides, and PCBs. One or more of these parameter groups may be eliminated from the Round 2 analyses if there are no detections in the Round 1 samples. CDM will identify the parameters to be eliminated from Round 2 (if any) and discuss them with EPA prior to collecting the Round 2 samples.

5.3.5.2 Surface Water, Groundwater Seepage, and Sediment Sampling

Surface water, groundwater seepage, and sediment samples will be collected to characterize the nature and extent of contamination in order to support RI and ecological and human health risk assessments. Since the site is currently identified as a groundwater plume with an unknown source (EPA 2006a), the major pathway for contamination of surface water and sediment is via discharge of contaminated groundwater to the Rio Maunabo. Accordingly, the surface water, groundwater seepage, and sediment program focuses on those areas where contaminated groundwater is expected to discharge. If during the investigation it is determined that VOC contaminated groundwater is being discharged into Quebrada Arenas, CDM will recommend to EPA the collection of surface water, groundwater seepage and sediment samples in Quebrada Arenas.

One round of surface water and sediment samples will be collected at seven locations in the Rio Maunabo. Surface water and sediment samples will be collected from the stream and streambed, respectively. In addition, one groundwater seepage sample will be collected from each of the five temporary piezometers installed as part of the groundwater/surface water interaction investigation described in Section 5.3.3.6. The location of the surface water, sediment, and groundwater/surface water interaction temporary piezometer samples are shown on Figure 5-3. Specific locations of the surface water and sediment samples in the field will be based on actual field conditions (such as amount of sediment available) and biased towards sedimentation locations (such as the slower flowing portions or the inside of stream bends, where lower flow velocities promote sediment deposition). Additional downstream sediment samples will be recommended to EPA if contamination is found in the furthest downgradient sample.

Sediment samples will be collected from a depth of 0 to 6 inches below the sediment surface. Surface water samples will be collected directly into the sample containers. Temporary piezometer groundwater seepage samples will be collected with a bailer. A minimum of three volumes of water will be purged from each piezometer prior to sampling. After the bailed samples are taken, diffusion bags will be placed inside the piezometers to collect VOCs for a time-weighted average concentration over two days. Both water and sediment samples will be collected using EPA-approved methodologies which will be fully detailed in the QAPP.

Surface water and groundwater seepage samples collected from the above locations will be analyzed for trace level VOCs, TCL SVOCs, pesticides/PCBs, and TAL metals, cyanide, alkalinity, ammonia, hardness, nitrate/nitrite, TKN, sulfate, sulfide, chloride, TOC, TDS, and TSS. In addition, CDM will collect field measurements including temperature, conductivity, pH, turbidity, DO, and redox potential (as Eh) at each surface water sampling location and at each temporary piezometer sample location.

Sediment samples will be analyzed for full TCL/TAL parameters, grain size, pH, and TOC.

5.3.5.3 Sub-Slab and Indoor Air Samples (Optional)

There is a potential for VOC vapors from the groundwater plume to migrate to structures above the plume and affect indoor air quality. Vapor intrusion is assessed by collecting sub-slab air samples (below basements or foundation slabs) and air samples from interior spaces of residences or other structures. Currently, information about the depth and lateral extent of the plume and the nature of materials between the groundwater plume and the surface are not known. The location of the contaminant source or sources is currently unknown and the specific contaminants to target for sub-slab and vapor sampling have not been defined. Vapor intrusion samples are contingent upon the results of the other activities proposed in the work plan, therefore, sub-slab and indoor air sampling are considered optional and will be performed only with EPA's approval.

CDM will evaluate the distribution of VOCs in groundwater based on the screening survey and monitoring well data. If VOCs are present in groundwater beneath buildings or soil in the source area, CDM will prepare a letter report defining the estimated boundaries of the groundwater contamination and identifying potentially impacted residences or buildings. The letter report will recommend locations for sub-slab and indoor air sampling. CDM will discuss the recommendations with EPA and upon EPA's approval, will conduct sub-slab sampling at the targeted building(s). Indoor air sampling will be conducted if the sub-slab sampling results indicate the potential for indoor migration of VOCs to indoor air.

Installation of sub-slab probes and air sampling will be conducted in accordance with the *Draft Guidance for Evaluation of the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (EPA 2002 or most current version).

For cost estimating purposes, it is assumed that four initial sub-slab samples and four concurrent sub-slab/indoor air samples (eight samples total) will be collected from residences or buildings in Maunabo. The concurrent subslab/indoor air samples will be collected only if VOCs are detected in the initial sub-slab samples. If indoor air sampling is conducted, it is estimated that one ambient air sample will be collected in conjunction with the indoor air sampling.

Sub-slab sampling will require installation of sampling ports through the slabs on the buildings. A 1.5-inch diameter hole will be drilled through the concrete slab so a stainless steel tube can be pushed one foot into the material below the slab for vapor testing. One air canister will be placed in the ground floor of each building for 24 hours. Upon retrieval, the air samples will be shipped to the laboratory for VOC analysis using EPA Method TO-15 with SUMMA canisters. Specific VOC compounds will be selected based on the results of the groundwater screening and monitoring well sampling. Procedures for air vapor sampling will be detailed in the site-specific QAPP.

Indoor air samples will be collected from the main living floor of the home if VOCs are detected above levels of concern specified by Region 2 in the initial subslab samples. In order to prevent interference, crawl space vents (if present) will be closed prior to conducting indoor air sampling. The field team will survey the area for any household products or conditions that could affect the indoor air sampling results. For the concurrent sampling, one air canister will be placed in the main living floor of the home and one canister will monitor sub-slab vapors for a period of 24 hours. Ambient air samples will be collected upwind of the sampling area, concurrently with the indoor air samples. Upon retrieval, the air samples will be shipped to the laboratory for VOC analysis using EPA Method TO-15 with SUMMA canisters. Specific VOC compounds will be selected based on the results of the groundwater screening and monitoring well sampling. Procedures for air vapor sampling will be detailed in the site-specific QAPP.

5.3.6 Ecological Characterization

An ecological characterization of the site will be conducted to describe existing conditions relative to vegetation community structure, wildlife utilization, and sensitive resources such as surface waters and wetlands. Based on the current understanding of the site contamination and the existing CSM, much of the contamination occurs in groundwater and is not available to ecological receptors. Potential impact to ecological receptors occurs in areas where groundwater discharges to water bodies, which will be determined during the investigation. In addition, ecological receptors may also be exposed to the contaminants in surface water and sediment of the Rio Maunabo.

Groundwater flow in the vicinity of the VOC impacted wells is expected to be toward Rio Maunabo. The ecological characterization will be conducted at the Rio Maunabo and limited to these areas where potential groundwater discharge may occur. It will consist of a review of existing information, an ecological field investigation, and identification of threatened/endangered species and critical habitats. If during the investigation it is determined that VOC contaminated groundwater is being discharged into Quebrada Arenas, the ecological investigation will be expanded to include Quebrada Arenas.

Critical habitat is defined in the Endangered Species Act as:

(i) the specific areas within the geographical area currently occupied by a species, at the time it is listed in accordance with Section 4 of the Act, on which are found those physical or biological features (a) essential to the conservation of the species, and (b) which may require special management considerations or protection, and

(ii) specific areas outside the geographical area occupied by a species at the time it is listed upon a determination by the Secretary that such areas are essential for the conservation of the species.

5.3.6.1 Ecological Field Investigation

The ecological field investigation will be conducted to characterize the terrestrial and aquatic communities associated with groundwater discharge areas and aquatic communities in the Rio Maunabo. Habitat conditions will be visually inspected by walking the site and recording observations of species composition and relative diversity and abundance, habitat association, and surface water conditions. Field observations will be recorded in logbooks and photographs will be taken to record both representative and unusual site conditions that would influence conclusions regarding potential contamination pathways, food chain effects, receptor identification, and risks to floral and faunal communities. The following information will be gathered during the field survey:

- General aquatic habitat conditions (e.g., water velocity, bottom substrate, channel width, channel depth, and extent of bank vegetation cover) along the water bodies. The Physical Characterization/Water Quality Field Data Sheet and the Habitat Assessment Field Data Sheet included in EPA's *Rapid Bioassessment Protocols for Use in Streams and Rivers* (EPA 1989b) may be used as tools to complete the characterization of the aquatic habitats.

- Vegetation community/cover types and observed vegetative species makeup of each community, including dominant species and general observation of abundance and diversity within each cover type, at and in areas related to the site.

- Wildlife use observations including wildlife habitats, species, wildlife concentrations areas, and habitat use activities.

- General surficial soil conditions.

- Indications of environmental stress that could be related to site contaminants.

An ecological description will be prepared for the RI report and/or SLERA that discusses the vegetative communities, wildlife habitats, suspected surface water drainage pathways, and observed areas of environmental stress or disturbance. The following information will also be prepared and presented: observed potential surficial migration pathways; vegetation communities and composition; observed terrestrial and aquatic wildlife habitats; observed and expected wildlife utilization of the site; potential occurrence of state and federal threatened, endangered, or rare species and critical habitats; and observed ecological impairments.

5.3.6.2 Identification of Endangered and Special Concern Species

The Endangered Species Act endeavors to conserve ecosystems inhabited by endangered or threatened species, and to protect the species themselves. The presence of any Commonwealth or federal threatened or endangered wildlife or plant species, or significant habitats at the site or surrounding area will be determined. EPA and the Puerto Rico Department of Natural Resources will be consulted to aid in this determination. Written communication from these agencies will be presented in the ecological risk assessment report.

Habitats essential to the growth and survival of rare plants and animals are considered critical habitats. Site walks conducted during the ecological characterization will identify critical habitats and the presence of these habitats will be noted in field logbooks. In addition, impairment (stressed vegetation, single species habitat) of critical habitats will be noted in field logbooks.

5.3.7 Geotechnical Survey

This subtask will not be utilized for this work assignment.

5.3.8 Disposal of Field Generated Waste

A subcontractor will be procured that will be responsible for the removal and proper disposal of all IDW, including drilling cuttings, waste soils, liquids, solids, and personal protective equipment. Representative waste samples will be collected and analyzed by a laboratory to characterize the waste. A technical statement of work will be prepared for the procurement of the waste hauling and disposal subcontractor under Subtask 5.1.11. Field oversight and health and safety monitoring will be conducted during all waste disposal field activities.

5.4 Task 4 - Sample Analysis

Section 5.3 and Table 5-1 specify the analyses for each type of samples. Details are summarized below.

- Groundwater Screening Samples: LDL VOCs, with 24-hour turn-around for faxed results.
- Surface Water and Groundwater Seepage Samples: Surface water samples will be analyzed for trace level VOCs, TCL SVOCs, pesticides/PCBs, TAL metals, cyanide, hardness, alkalinity, ammonia, nitrate/nitrite, TKN, sulfate, sulfide, chloride, TOC, TDS, and TSS.
- Sediment Samples: Sediment samples will be analyzed for full TCL/TAL parameters, grain size, pH, and TOC.
- Monitoring Well Samples: Monitoring well samples will be analyzed for trace level VOCs, TCL SVOCs, pesticides/PCBs, TAL metals, cyanide, chloride, methane, ethane, ethene, nitrate/nitrite, sulfate, sulfide, TOC, TSS, TDS, ammonia, alkalinity, hardness, and TKN. Ferrous iron analysis will be conducted onsite.
- Soil Samples (Optional): Soil samples will be analyzed for full TCL/TAL parameters, grain size (one-half of the samples), pH, and TOC.
- Sub-Slab and Indoor Air Samples (Optional): Sub-slab and indoor air samples will be analyzed for selected VOCs based on groundwater screening and monitoring well data by the EPA Method TO-15 method by an EPA laboratory through the Flexibility Clause.

5.4.1 Innovative Methods/Field Screening Sample Analysis

This subtask is not applicable to the remedial investigation.

5.4.2 Analytical Services Provided via CLP or DESA

RAS samples will be analyzed in compliance with the FASTAC Policy. CDM will pursue the use of the CLP or DESA and alternatives to standard CLP analysis will be sought with the EPA RSCC, prior to any sample collection activities and analyses via the subcontract RAC II BOA laboratory. Under the CLP "flexibility clause" modifications are often made to CLP SOWs, enabling achievement of MDLs that may meet the stated criteria.

CDM will implement the EPA Region 2 policy as shown below:

Tier 1:	DESA Laboratory (including ESAT support)
Tier 2:	EPA CLP
Tier 3:	Region specific analytical services contracts or use CLP flexibility clause
Tier 4:	Obtaining analytical services using subcontractors via field contracts (such as the RAC II BOA subcontractors)

All fixed laboratory analytical needs will to be submitted to the EPA RSCC regardless of the EPA or CLP laboratories' ability to perform. CDM will utilize the RAC II laboratory BOA only in the event that the first three tiers are not available.

5.4.3 Subcontractor Laboratory for Non-RAS Analyses

CDM has procured subcontract laboratories for analysis of non-RAS samples, including fast turnaround (24 hour) low detection limit VOCs. If DESA does not have the capacity to analyze the non-RAS parameters listed in Section 5.4, the samples will be analyzed by a RAC II BOA subcontract laboratory.

CDM will select laboratory subcontractors from the BOA based on the ability to meet analytical QA/QC requirements in the project-specific SOWs for non-RAS analytical services. The laboratory subcontractor will be selected by EPA-approved criteria and will follow the most current EPA protocols and Region II QA requirements. The CDM RQAC will ensure that the laboratory meets all EPA requirements for laboratory services. Project-specific SOWs govern the analytical work performed by the BOA laboratory subcontractors. CDM has provided EPA with copies of the QA manuals and/or QA plans of the BOA subcontract laboratories. CDM will monitor the subcontractor laboratory's analytical performance. The number of samples and analytical parameters are defined on Table 5-1. The analytical test methods, levels of detection, holding times, parameters, field sample preservation and QC samples will be provided in the QAPP.

5.5 Task 5 - Analytical Support and Data Validation

CDM will validate any non-RAS environmental samples analyzed by the subcontract laboratory. EPA or DESA will validate all other analytical data for the RI investigation.

5.5.1 Collect, Prepare and Ship Samples

Sample preparation and shipment is included under Task 3.

5.5.2 Sample Management

The CDM Analytical Services Coordinator (ASC) will be responsible for all RAS CLP laboratory bookings and coordination with the Sample Management Office (SMO), RSCC, DESA, and/or other EPA sample management offices for sample tracking prior to and after sampling events.

For all RAS activities, CDM will notify the Contract Laboratory Analytical Support Services (CLASS) to enable them to track the shipment of samples from the field to the laboratories and to ensure timely laboratory receipt of samples. Sample trip reports will be sent directly to the RSCC and the EPA RPM within seven working days of final sample shipment, with a copy sent to the CDM ASC.

The CLP laboratories will be responsible for providing organic and inorganic analytical data packages to EPA for data validation.

Samples analyzed by the DESA laboratory and/or the subcontract laboratory will be coordinated by the ASC. All analytical data packages from the subcontract laboratory will be sent directly to CDM for data validation. If requested, CDM will send these validated data packages to EPA for QA review purposes. The data will be delivered in a format conducive to database input. CDM will provide the subcontract laboratory with a format for the electronic data deliverable.

5.5.3 Data Validation

All RAS samples will be analyzed by a laboratory participating in the CLP and all analytical data will be validated by EPA. The non-RAS data will be validated by CDM validators, who will use the requirements and the QC procedures outlined in the associated methods and as per the analytical SOW for the laboratory subcontractor. The validation will determine the usability of the data. All validated data results will be presented in an appendix to the RI report. A data validation report summarizing the results of data validation will be submitted to EPA after all data have been validated.

Data validation will verify that the analytical results were obtained following the protocols specified in the CLP SOW, and are of sufficient quality to be relied upon to prepare an HHRA, an RI report, and to support a ROD.

5.6 Task 6 - Data Evaluation

This task includes efforts related to the compilation of analytical and field data. All validated and unvalidated data will be entered into a relational database that will serve as a repository for data analysis, risk assessment, geographic information system (GIS), and data visualization. Environmental Quality Information Systems (EQuIS) will be used as the database. Tables, figures, and maps will be generated from the data to support preparation of the data evaluation report, the RI report, the HHRA report, the SLERA report, and the FS report. The data will be reviewed and carefully evaluated to identify the nature and extent of site-related contamination.

5.6.1 Data Usability Evaluation

CDM will evaluate the usability of data collected during the RI, including any uncertainties associated with the data. Previous investigations had different goals than the RI/FS that may influence the extent to which some of the data should be used in the RI/FS or risk assessments. Field sampling techniques, laboratory analytical techniques, and data validation should all be considered. Data usability will be evaluated against DQOs for the RI and for the risk assessments, as identified in the QAPP, prior to use in these reports. Any qualifications to the data usability will be discussed in the quality assurance section of any reports presenting data.

5.6.2 Data Reduction, Tabulation and Evaluation

CDM will evaluate, interpret, and tabulate data in an appropriate presentation format for final data tables. The following will be used as general guidelines in the preparation of data for use in the various reports.

- Tables of analytical results will be organized in a logical manner such as by sample location number, sampling zone, or some other logical format.

- Analytical results will not be organized by laboratory identification numbers because these numbers do not correspond to those used on sample location maps. The sample location/well identification number will always be used as the primary reference for the analytical results. The sample location number will also be indicated if the laboratory sample identification number is used.

- Analytical tables will indicate the sample collection dates.

- The detection limit will be indicated in instances where a parameter was not detected.

- Analytical results will be reported in the text, tables and figures using a consistent and conventional unit of measurement such as micrograms/liter for groundwater analyses and milligrams/kilogram for sediment analyses.
- EPA's protocol for eliminating field sample analytical results based on laboratory/field blank contamination results will be clearly explained.

- If the reported result has passed established data validation procedures without rejection, it will be considered valid.

- Field equipment rinsate blank analytical results will be discussed in detail if decontamination solvents are believed to have contaminated field samples.

Detailed information concerning the hydrogeological and physical characteristics of the site and the surrounding area will be gathered, reviewed, and evaluated for inclusion in the data evaluation report, the RI report, the RA reports, and the FS report. The purpose of these activities will be to provide a detailed understanding of the site physical features and to assess how these features may affect contaminant source areas, potential migration pathways, and potential remedial alternatives.

Database Management
CDM will use a relational environmental database and standard industry spreadsheet software programs to manage all data related to the sampling program. The system will provide data storage, retrieval, and analysis capabilities, and be able to interface with a variety of spreadsheet, word processing, statistical, GIS, and graphics software packages to meet the full range of site and media sampling requirements necessary for this work assignment.

Data collected during the RI will be organized, formatted, and input into the database for use in the data evaluation phase. All data entry will be checked for quality control throughout the multiple phases of the project. Data tables comparing the results of the various sampling efforts will be prepared and evaluated. Data tables will also be prepared that compare analytical results with both state and federal ARARs. Electronic data submitted will comply with EPA's Electronic Data Deliverable (EDD) requirements.

Data Mapping
CDM will create a GIS in order to facilitate spatial analysis of the data and to generate figures for reports and presentations. The GIS will have geographic base layers consisting of various kinds of maps that depict regional and local physiographic features such as roads, buildings, water bodies, railroads, and topography. Site-specific features derived from the site and study area survey results will be added to complete the base layers. As samples are collected and wells are installed, the locations will be registered in the GIS. Historical and current analytical results for each sample location will be added, creating the capability to conduct functional spatial queries of the data to show where parameters of interest are sampled, detected, and exceed regulatory standards or criteria, by date and depth. This functionality will be used to support data interpretation for preparation of the RI report.

The GIS will also serve as the primary platform for figure and map generation to support both the RI and FS reports and presentations such as public meetings. Figures will be generated in plan view and cross section to show the extent of groundwater contamination. Graphic illustrations in the data evaluation report and/or the RI report will include geological profiles, cross-sections, water table maps, contaminant isoconcentration maps, and longitudinal and cross-sectional profiles of groundwater contamination. Plan view maps and figures will be generated using GIS to facilitate plan-view spatial data analysis. Figures will be generated to illustrate site features, historical sample locations, historical sampling results, current sample locations, current sampling results, locations where groundwater quality exceeds regulatory standards and criteria, and monitored natural attenuation (MNA) parameter concentrations relative to contaminant concentrations.

5.6.3 Modeling

Groundwater modeling is not required by EPA at this time. If during the course of this RI/FS a modeling effort is requested by EPA, EPA will issue an amendment to this work assignment. CDM will then perform an initial assessment and submit recommendations to EPA.

For the initial modeling assessment, relevant and available site data will be reviewed, including technical documents/reports and raw data from adjacent (and offsite) areas that may be within the anticipated model domain. Some of the analytical work required to make the assessment will already have been carried out during the RI. The initial modeling assessment will include the following activities:

- Review of:
    - Regional hydrogeological setting of the site
    - Site-specific data:
        - Nature and extent of contamination
        - Hydraulic properties of the aquifer(s)
        - Geometry and lithology of the aquifer(s)
    - Potential model boundaries and boundary conditions
    - Data accuracy and adequacy

- Preparation of recommendations section

Until the initial data review and modeling assessment is carried out, definition of a technical approach for site modeling is considered to be premature. If EPA concurs with any recommendations for modeling, then a detailed work plan and an associated modeling budget will be prepared for EPA's review. This work plan would detail the technical approach and outline specific tasks to be carried out. It would also provide a preliminary conceptual model of the site that would serve as the basis for model development.

5.6.4 Technical Memorandum

Upon completion of data evaluation, CDM will prepare a data evaluation report for review and approval by EPA. The data evaluation report will establish site characteristics such as the media contaminated, the extent of contamination, and the physical boundaries of the contamination. If additional data are needed to determine the extent of contamination, CDM will provide recommendations to EPA for supplemental work at the Maunabo Site. The data evaluation report will include data results but will not include a full evaluation or interpretation of the analytical data. Full data evaluation will be performed in the RI Report as outlined in Task 9. The data evaluation report will require technical and QA review prior to submittal to EPA.

5.7 Task 7 - Assessment of Risk

CDM will conduct a baseline HHRA and a SLERA for the Maunabo site. The objective of the risk assessments is to provide an evaluation of potential threats to human health and the environment that could occur from exposure to contaminants originating from the site in the absence of any remedial action. The risk assessments also provide the basis for determining whether or not remedial action is necessary and the justification for performing remedial actions.

5.7.1 Human Health Risk Assessment

The baseline HHRA will determine the potential adverse human health effects that could occur from exposure to contaminants originating from the site, in the absence of any actions to control or mitigate the releases. If the HHRA determines that potential adverse health effects exist and remediation is warranted, the HHRA will be used to focus remediation on the contaminated media and exposure pathways posing the greatest risk. Furthermore, the HHRA can be utilized to compare the potential health impacts of various remedial alternatives.

The HHRA will be performed in accordance with EPA guidance set forth in the following documents:

- *Risk Assessment Guidance for Superfund: Human Health Evaluation Manual, Part A* (EPA 1989a)

- *Risk Assessment Guidance for Superfund: Human Health Evaluation Manual, Part B, Development of Risk Based Preliminary Remediation Goals* (EPA 1991a)

- *Risk Assessment Guidance for Superfund: Human Health Evaluation Manual, Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments* (EPA 2001a)

- *Risk Assessment Guidance for Superfund: Volume I: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment Interim Final* (EPA 1999b)

- *Exposure Factors Handbook, Vol I, II and III* (EPA 1997a)

- *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors* (EPA 1991b)

- *Final Guidance for Data Usability in Risk Assessment* (EPA 1992a)

- *Health Effects Assessment Summary Tables FY-1997 Annual* (EPA 1997b)

- *Integrated Risk Information System (IRIS) (on-line data base of toxicity measures)* (most current version)

- *EPA Region 9 Preliminary Remediation Goals* (EPA 2004b or most current version)

Additional guidance which addresses site-specific issues and chemical contaminants will also be consulted.

CDM will evaluate key contaminants identified in the HHRA for receptor exposure and perform an estimate of the level of key contaminants reaching human receptors. CDM will use EPA's standardized planning and reporting methods as outlined in EPA's Risk Assessment Guidance for Superfund (RAGS Part D).

The following activities under this subtask will form the basis for the HHRA.

5.7.1.1 Draft Human Health Risk Assessment Report

The draft baseline human health risk assessment report will be submitted after EPA has approved the PAR, described in Section 5.1.13. The draft HHRA report will cover the following components.

Hazard Identification

CDM will review available information on the hazardous substances present at the site, and identify the COPCs. The COPCs to be used in the risk assessment will be selected in accordance with EPA Region 2 procedures as presented in RAGS Part A. Additional selection criteria that will be used to identify the COPCs at the site include the following:

- Frequency of detection in analyzed environmental medium (e.g., groundwater)
- Historical site information/activities (i.e., site-related)
- Chemical toxicity (potential carcinogenic and noncarcinogenic effects, weight of evidence for potential carcinogenicity)

- Chemical properties (e.g., mobility, persistence and bioaccumulation)
- Significant exposure routes
- Risk-based concentration screen using EPA Region 9 Risk Based Concentrations and media specific chemical concentrations (i.e., maximum detected concentrations)

In general, nutrients such as calcium, magnesium, potassium, and sodium are not quantitatively evaluated in the risk assessment.

Statistical analysis of the data will be performed (i.e., tests for distribution, calculation of upper confidence levels [UCLs]).

Toxicity Assessment

The toxicological properties of the selected COPCs using the most current toxicological human health effects data will be presented. Chemicals that cannot be quantitatively evaluated due to a lack of toxicity values will not be eliminated as COPCs on this basis. These chemicals will instead be qualitatively addressed for consideration in risk management decisions for the site.

Toxicity values and toxicological information regarding the potential for carcinogens and non-carcinogens to cause adverse health effects in humans will be obtained from the hierarchy of EPA sources in accordance with EPA OSWER Directive 9285.7-53 (EPA 2003). The primary source will be EPA's IRIS on-line database, which is updated regularly, provides chemical-specific toxicity values and toxicological information that have undergone peer review and represent an EPA scientific consensus. If toxicity values are not available from IRIS, the EPA's PPRTVs will be consulted. PPRTVs are developed by EPA's Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center (STSC) on a chemical specific basis when requested by EPA's Superfund program. If no toxicity values are available from PPRTVs, then other sources such as the most recent Health Effects Assessment Summary Tables (HEAST) will be used to select toxicity values. The CDM risk assessor will coordinate with EPA, if necessary, to acquire toxicity values from NCEA for compounds that are not in IRIS or the PPPTV.

Toxicity values include slope factors for carcinogens and reference doses (RfDs) and reference concentrations (RfCs) for non-carcinogens. In the HHRA, a slope factor, expressed in the unit of milligrams per kilogram per day $mg/(kg/day)^{-1}$, is used to estimate an upper-bound probability of an individual developing cancer as a result of a lifetime of exposure to a particular level of a potential carcinogen.

For the evaluation of non-carcinogenic health effects in the risk assessment, chronic and subchronic RfDs or RfCs are used. A chronic RfD or RfC is an estimate of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without appreciable risk of deleterious effects during a lifetime. Chronic RfDs or RfCs are generally used to evaluate the potential non-carcinogenic health effects associated with exposure periods between six years and a lifetime. Subchronic RfDs or RfCs aid in the characterization of potential non-cancer effects associated with shorter-term exposure (i.e., less than six years).

Toxicity endpoints/target organs for non-carcinogenic COPCs will be presented for those chemicals showing hazard quotients greater than one. If the hazard index is greater than one due to the summing of hazard quotients, segregation of the hazard index by critical effect and mechanism of action will be performed as appropriate.

Exposure Assessment

Exposure assessment involves the identification of the potential human exposure pathways at the site for present and potential future land-use scenarios. Potential release and transport mechanisms will be identified for contaminated source media. Exposure pathways will also be identified that link the sources, locations, types of environmental releases, and environmental fate with receptor locations and activity patterns. An exposure pathway is considered complete if it consists of the following elements:

- A source and mechanism of release
- A transport medium
- An exposure point (i.e., point of potential contact with a contaminated medium)
- An exposure route (e.g., ingestion) at the exposure point

All exposure pathways under the current and future land-use scenarios will be presented; however, only some may be selected for quantitative analysis. Justifications will be provided for those exposure pathways retained and for those eliminated.

Based on the initial site visit to the Maunabo site and information regarding current and future land use, the potential receptors under the current land-use scenario may include residents (adults and children) and workers. If the investigation shows that the contaminated groundwater discharges into surface water in the vicinity of the site, then recreational users will also be included. For the future land-use scenario, in addition to residents (adults and children), workers, and possible recreational users, construction workers will be included. The potential exposure pathways for each receptor are listed below.

- Residents (Adults and Children)
  Surface soil (if soil samples are collected)
    - Incidental Ingestion
    - Incidental Dermal contact
    - Inhalation of fugitive dust

  Groundwater
    - Ingestion
    - Dermal contact
    - Inhalation of volatiles while showering

  Indoor Air vapors
    - Inhalation of volatiles

- Workers (Adults)

Surface soil (if soil samples are collected)
- Incidental Ingestion
- Incidental Dermal contact
- Inhalation of fugitive dust

Groundwater
- Ingestion
- Dermal contact

Indoor Air vapors
- Inhalation of volatiles

■ Recreational Users (Adults and Children) - only if the investigation data show that the contaminated groundwater discharges to surface water in the vicinity of the site

Surface Water
- Incidental ingestion
- Dermal contact

Sediment
- Incidental ingestion
- Dermal contact

Fish Consumption

■ Construction Workers (Adults)

Surface/subsurface soil (if soil samples are collected)
- Incidental ingestion
- Incidental dermal contact
- Inhalation of fugitive dust

Groundwater
- Ingestion
- Dermal contact

Exposure point concentrations will be developed for each COPC in the risk assessment, for use in the calculation of daily intakes. The concentration is the 95 percent UCL on the arithmetic mean, or the maximum detected value (whichever is lower).

Chronic daily intakes, expressed as mg/kg-day, will be calculated and used in conjunction with toxicity values to provide quantitative estimates of carcinogenic risk and non-carcinogenic health effects.

Exposure assumptions used in chronic daily intake calculations will be based on information contained in EPA guidance, site-specific information, and professional judgement. These assumptions are generally 90th and 95th percentile parameters, which represent the reasonable maximum exposure (RME). The RME is the highest exposure that is reasonably expected to occur at a site. If potential risks and hazards exceed EPA target levels, then Central Tendency Exposures (CTE) will be evaluated using 50th percentile exposure variables.

The exposure assessment will identify the magnitude of actual or potential human exposures, the frequency and duration of these exposures, and the routes by which receptors are exposed. The assumptions will include information from the *Standard Default Assumptions Guidance and the Exposure Factors Handbook* (EPA 1997a). Site specific information will be used where appropriate to verify or refine these assumptions. In developing the exposure assessment, CDM will develop reasonable maximum estimates of exposure for both current land-use conditions and potential future land-use conditions at the site.

Risk Characterization

In this section on the risk assessment, toxicity and exposure assessments will be integrated into quantitative and qualitative expressions of carcinogenic risk and non-carcinogenic hazards.

Carcinogenic risks are estimated as the incremental probability of an individual developing cancer over a life time as a result of exposure to a potential carcinogen. Per RAGS, the slope factor directly converts estimated daily intakes averaged over a lifetime to incremental risk of an individual developing cancer. This carcinogenic risk estimate is generally an upper-bound value since the slope factor is often an upper 95th percentile confidence limit of probability of response based on experimental animal data used in the multistage model.

The potential for non-cancer effects will be evaluated by comparing an exposure level over a specified time period with a reference dose derived for a similar exposure period. This ratio of exposure to toxicity is referred to as a hazard quotient. This hazard quotient assumes that there is a level of exposure below which it is unlikely even for sensitive populations to experience adverse health effects; however, this value should not be interpreted as a probability. Generally, the greater the hazard quotient is above unity, the greater the level of concern.

Carcinogenic risks and non-carcinogenic hazard index (HI) values will be combined across chemicals and exposure pathways as appropriate. EPA recommends a target value or risk range (i.e., HI = 1 for non-carcinogenic effects or carcinogenic risk = 1×10^{-4} to 1×10^{-6}) as threshold values for potential human health impacts. The results presented in the spreadsheet calculations will be compared to these target levels and discussed. Characterization of the potential risks associated with the site provides the EPA risk manager with a basis for determining whether additional response action is necessary at the site and a basis for determining residual chemical levels that are adequately protective of human health.

Identification of Limitations/Uncertainties

In any risk assessment, estimates of potential carcinogenic risk and non-carcinogenic health effects have numerous associated uncertainties. The primary areas of uncertainty and limitations will be qualitatively discussed. Quantitative measures of uncertainty will involve the calculation of central tendencies. Central tendency evaluation involves the use of 50th percentile input parameters in risk and hazard estimates as opposed to 90th or 95th percentile parameters used in the RME calculations. The 50th percentile parameters are considered representative of the general receptor population, but may underestimate the health risk to sensitive receptors. The chemicals driving the risk assessment will be evaluated using these average exposure assumptions and the 95 percent UCL concentrations. The central tendency risks will be discussed in relation to RME risks. Central tendency analyses will only be calculated for pathways in which RME risks are considered above *de minimus* levels (carcinogenic risk above 1×10^{-6} and/or HI above 1.0).

The CDM SM will coordinate with the EPA RPM and submit draft/interim deliverables as outlined in the Risk Assessment Guidance for Superfund - Part D. All data will be presented in RAGS Part D Format. The draft HHRA report will provide adequate details of the activities and be presented so that individuals not familiar with risk assessment can easily follow the procedures.

5.7.1.2 Final Human Health Risk Assessment Report

CDM will submit the final human health risk assessment report, incorporating EPA review comments.

5.7.2 Screening Level Ecological Risk Assessment

If the data from the investigation indicates that contaminated groundwater discharges to surface water in the vicinity of the site, then CDM will conduct a SLERA. The SLERA will utilize surface water and sediment data from the site to evaluate potential risks to sensitive ecological receptors from site contaminants, in areas identified as likely to receive discharge from site groundwater. This assessment will be prepared in accordance with the *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (Interim Final)* (EPA 1997c) and *Guidelines for Ecological Risk Assessment* (EPA 1998a).

5.7.2.1 Draft Screening Level Ecological Risk Assessment

The draft screening level ecological risk assessment report will be composed of the following four components to assess site-related potential ecological risks for an RME scenario:

- Problem Formulation
- Ecological Effects Evaluation
- Exposure Estimates
- Risk Calculation

These four components are discussed in detail below.

Problem Formulation

The problem formulation will include descriptions of site history, environmental setting, nature and extent of contamination, habitat characterization, identification of contaminants of potential ecological concern (COPECs), contaminant fate and transport mechanisms, and ecotoxicity and potential receptors. In addition, assessment and measurement endpoints for the SLERA will also be included.

COPECs will be identified in order to narrow the focus of the SLERA and to identify dominant site risk. In each environmental medium the maximum detected concentrations will be compared to the regulatory screening levels. When the maximum detected concentration of a contaminant exceeds its regulatory screening level, the contaminant will be selected as a COPEC. Maximum detection limits of non-detected contaminants will be compared to the screening levels. Non-detected contaminants with detection limits exceeding regulatory screening levels will be added to the lis of COPECs. Contaminants lacking screening levels will be retained as COPECs for further evaluation.

The following regulatory screening levels will be utilized for the COPEC selection:

- Surface Water
  - Puerto Rico Surface Water Quality Standards (1990)
  - National Recommended Water Quality Criteria (EPA 2002)
  - National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (1998)

- Sediment
  - Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario - LEL and SEL (Ontario August 1993)
  - NOAA Screening Quick Reference Tables (1998)
  - Washington State Department of Environment Freshwater Sediment Quality Values (1997)

Chemicals will not be eliminated as COPECs due to the chemical's frequency of detection or by comparison to background concentrations. Therefore, frequency of detection and background concentrations are not factors in the selection of COPECs for the SLERA.

Site-related receptor species or surrogates will be chosen as potential ecological representatives of the trophic levels and habitats at and surrounding the site. Selection will be based on an integration of the types and distribution of COPECs, habitats, range and feeding habits of the potential ecological receptors, and relationships between the observed/expected species in the areas of concern. Other considerations include species that are Trustee or regulatory concerns.

The assessment endpoint for the ecological risk assessment is the disruption of ecological community structures via reduction of ecological populations. It will be assumed that a reduction of an ecological population may occur through the loss of normally-functioning individuals of the population. Assessment endpoints will be evaluated through measurement endpoints. Measurement endpoints to evaluate potential ecological impacts will be the benchmark toxicity endpoints from the literature. Individual toxicity endpoints such as survival, reproductive effects, and growth impacts will be considered.

Effects Assessment

The effects assessment will determine the ecological toxic effects of COPECs on the potential ecological receptors. A database and literature search will be performed to identify COPEC benchmark toxicity values to estimate the potential ecological risks.

Chronic no-observed-adverse-effect levels (NOAELs) for COPECs will be selected to represent the benchmark toxicity values in the SLERA as they ensure that risk is not underestimated (EPA 1997c). If chronic NOAELs are not available, acute or chronic lowest-observed-adverse-effect levels (LOAELs) or median lethal doses (LD_{50}) will be used with a uncertainty factor to reflect the level of uncertainty. The following scheme (Calabrese and Baldwin 1993) will be used to obtain a chronic NOAEL for the adjusted benchmark toxicity values:

- Acute LD_{50} be multiplied by a uncertainty factor of 0.02
- Chronic LOAEL or chronic LD_{50} be multiplied by a uncertainty factor of 0.1
- Acute LOAEL be multiplied by a uncertainty of 0.04

When toxicity values are not available for the selected receptor species, the use of toxicity values from other animal studies will be necessary. No additional uncertainty factor will be applied to the available toxicity value if the value is for an animal within the same taxonomic class as the target receptor. Values for taxonomic classes other than the receptor species will not be used. If more than one toxicity value is available, the most conservative toxicity value for the most closely-related species to the target receptor will be used. CDM will also obtain benchmark toxicity values from open literature sources.

Exposure Estimates

The purpose of this section is to evaluate the potential for receptor exposure to COPECs. This evaluation involves identification of contaminant exposure pathways that may be of concern for ecological receptors and determination of the magnitude of exposure to the selected ecological receptors. A CSM will be included to identify complete exposure pathways.

The potential ecological receptors for the SLERA may have the potential to be exposed to COPECs in surface water and sediment in the vicinity of the site. Aquatic invertebrates, fish, and frog species will have considerable exposure to surface water and sediments throughout their life spans. Due to lack of established ecotoxicity values for fish and amphibian exposed to chemicals in sediment, the evaluation of sediment exposure to fish and frogs will not be made. Only the surface water pathway will be evaluated for the fish and frog receptors.

Contaminant exposures for other receptors, occur through direct contact with the contaminated media will be evaluated.

Risk Calculation

The risk calculation will evaluate the evidence linking site contamination with potential adverse ecological effects. Risk calculation to site ecological receptors will be determined on the basis of comparison of ecotoxicity values from the literature with exposure doses (hazard index approach). Hazard quotients (HQs) for all COPECs in an environmental medium will be summed and expressed as HIs for that medium. An HI less than one (unity) indicates that the COPECs in that environmental medium is unlikely to cause adverse effects.

Identification of Uncertainties and Limitations
To produce any risk assessment, it is necessary to make assumptions. Assumptions carry with them associated uncertainties which must be identified so that risk estimates can be put into perspective. CDM will discuss uncertainties and limitations associated with the SLERA.

SLERA Recommendations
If results of the SLERA indicate that potential for ecological adverse effects exists at the site, a recommendation for further ecological investigation will be made to EPA. Subsequently, EPA will determine whether a baseline ecological risk assessment is warranted.

5.7.2.2 Final Screening Level Ecological Risk Assessment Report
CDM will submit the final SLERA report to EPA, incorporating EPA's review and comments.

If the SLERA indicates the need for additional ecological investigation, and EPA agrees with the recommendation, a work plan letter will be prepared under Subtask 5.7.2.2. The work plan letter will outline the technical requirements to conduct further ecological investigations at the site and the associated costs for the work.

5.8 Task 8 - Treatability Studies/Pilot Testing
Applicable treatment technologies that may be suitable for the Maunabo site will be identified to determine if there is a need to conduct treatability studies.

5.8.1 Literature Search
CDM will research viable technologies that may be applicable to the contaminants of concern and the site conditions encountered. Upon completion of the literature search, CDM will provide a technical memorandum to the EPA RPM that summarizes the results. As part of this document, CDM will submit a plan that recommends performance of a treatability study and identifies the types and specific goals of the study. The treatability study will be designed to determine the suitability of remedial technologies to site conditions and addressing the type of contamination that exists at the site. If directed by EPA, CDM will prepare an addendum to the RI/FS work plan for the treatability study. An addendum for a treatability study is not included in the current work plan.

5.8.2 Treatability Study Work Plan (Optional)
If requested by the EPA, CDM will perform the following:

- Prepare a draft addendum to the RI/FS work plan that describes the approach for performance of the treatability study

- Participate in negotiations to discuss the final technical approach and costs required to accomplish the treatability study requirements

- Prepare a final work plan addendum and supplemental budget that incorporates the agreements reached during the negotiations

The treatability study work plan addendum will describe the treatment process and how the proposed technology or vendor (if proprietary) will meet the performance standards for the site. The work plan addendum will address how the proposed technology or vendor will meet all discharge or disposal requirements for treated material, air, water, and expected effluents. The proposed treatment and disposal of all material generated during the treatability study will be addressed.

The treatability study work plan addendum will describe the technology to be tested, test objectives, test equipment or systems, experimental procedures, treatability conditions to be tested, measurements of performance, analytical methods, data management and analysis, health and safety procedures, and residual waste management. The DQOs for the treatability study will also be documented. If pilot-scale treatability studies are to be done, the treatability study work plan addendum will also describe pilot plant installation and startup, pilot plant operation and maintenance procedures, and operating conditions to be tested. If testing is to be performed off-site, permitting requirements will be addressed. A schedule for performing the treatability study will be included with specific durations and dates, when available, for each task and subtask, including anticipated EPA review periods. The schedule will also include key milestones for which completion dates should be specified. Such milestones are procurement of subcontractors, sample collection, sample analysis and preparation of the treatability study report.

5.8.3 Conduct Treatability Studies (Optional)

CDM will conduct the treatability study in accordance with the approved treatability study addendum to the RI/FS work plan, QAPP, and HSP, to determine whether the remediation technology or vendor of the technology can achieve the performance standards.

The following activities are to be performed, when applicable, as part of the performance of the treatability study and pilot testing:

- Procurement of Test Facility and Equipment - CDM will procure the test facility and equipment necessary to execute the tests.

- Procurement of Subcontractors - CDM will procure subcontractors as necessary for test/study performance.

- Test and Operate Equipment - CDM will test the equipment to ensure proper operation, and operate or oversee operation of the equipment during the testing.

- Retrieve Samples for Testing - CDM will obtain samples for testing as specified in the treatability study work plan.

- Perform Laboratory Analysis - CDM will establish a field laboratory to facilitate fast-turnaround analysis of test samples, if economically and technically feasible.

- Characterize and dispose of residual wastes.

- Evaluate the test results.

5.8.4 Treatability Study Report (Optional)

CDM will prepare and submit the treatability study evaluation report that describes the performance of the technology. The study results will clearly indicate the performance of the technology or vendor compared with the performance standards established for the site. The report will also evaluate the treatment technology's effectiveness, implementability, cost and final results compared with the predicted results. In addition, the report will evaluate full-scale application of the technology, including a sensitivity analysis that identifies the key parameters affecting full-scale operation.

5.9 Task 9 - Remedial Investigation Report

CDM will develop and submit a remedial investigation report that accurately establishes site characteristics including the identification of contaminated media, definition of the extent of contamination in groundwater, soils, surface water, and sediments and delineation of the physical boundaries of contamination. CDM will obtain detailed sampling data to identify key contaminants and determine the movement and extent of contamination in the environment. Key contaminants will be identified in the report and will be selected based on toxicity, persistence, and mobility in the environment.

5.9.1 Draft Remedial Investigation Report

A draft RI report will be prepared in accordance with the format described in EPA guidance documents such as the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 1988). A draft outline of the report, adapted from the guidance document, is shown in Table 5-3. This outline should be considered a draft and subject to revision, based on the data obtained. EPA's SOW for this work assignment has provided a detailed description of the types of information, maps, and figures to be included in the RI report. CDM will incorporate such information to the fullest extent practicable.

Upon completion, the draft RI report will be submitted for review by a CDM Technical Review Committee (TRC), followed by a QA review. It will then be submitted to EPA for formal review and comment.

5.9.2 Final Remedial Investigation Report

Upon receipt of all EPA and other federal and Commonwealth written comments, CDM will develop responses to comments, and revise the report prior to submittal to EPA. When EPA determines that the report is acceptable, the report will be deemed the final RI report.

5.10 Task 10 - Remedial Alternatives Screening

This task covers activities for the development of appropriate remedial alternatives that will undergo full evaluation. A range of alternatives will be considered, including innovative treatment technologies, consistent with the regulations outlined in the NCP, 40 CFR Part 300, the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (OSWER Directive 9355.3-01 October 1988 or latest version), and other OSWER directives including 9355.4-03, October 18, 1989, and 9283.1-06, May 27, 1992, *Considerations in Ground Water Remediation at Superfund Sites*, as well as other applicable and more recent policies or guidance. CDM will also use EPA's 1996 final guidance *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Groundwater at CERCLA Sites*, which describes strategies and technologies for groundwater contaminated with chlorinated solvents.

CDM will investigate alternatives that will remediate or control contaminated media related to the site, as defined in the RI, to provide adequate protection of human health and the environment. The potential alternatives will encompass, as appropriate, a range of alternatives in which treatment is used to reduce the toxicity, mobility, or volume of wastes but vary in the degree to which long-term management of residuals or untreated waste is required, and will include one or more alternatives involving containment with little or no treatment, as well as a no-action alternative.

Based on EPA's presumptive remedy guidance (1996), the following alternatives, composed of treatment technologies for potentially affected media at the site, may be selected as representative technologies in the FS alternatives if they are deemed appropriate for chlorinated VOCs:

Groundwater

- No Action
- Groundwater treatment with air stripping, granular activated carbon, chemical/ultraviolet oxidation, permeable reactive barriers, and/or anaerobic biological reactors
- Monitored natural attenuation

Additional technologies may be evaluated if extremely high levels of contamination (e.g., DNAPL) are identified. Groundwater remedial alternatives will also include several disposal options for treated groundwater (e.g., recharge basins, discharge to a surface water body).

Based on the established remedial response objectives and the results of the risk assessments (Task 7), the initial screening of remedial alternatives will be performed according to the procedures recommended in *Interim Final Guidance for Conducting RI/FS under CERCLA* (EPA 1988).

The alternatives will be screened qualitatively against three criteria: effectiveness, implementability, and relative cost. A brief description of the application of these criteria is as follows:

- Effectiveness - The evaluation focuses on the potential effectiveness of technologies in meeting the remedial action goals; the potential impacts to human health and the environment during construction and implementation; and how proven and reliable the process is with respect to the contaminants and conditions at the site.

- Implementability - This evaluation encompasses both the technical and administrative feasibility of the technology. It includes an evaluation of treatment requirements, waste management, and relative ease or difficulty in achieving the operation and maintenance requirements. Technologies that are clearly unworkable at the site are eliminated.

- Relative Cost - Both capital cost and operation and maintenance cost are considered. The cost analysis is based upon engineering judgement, and each technology is evaluated as to whether costs are high, moderate, or low relative to other options within the same category.

The screening evaluation will generally focus on the effectiveness criterion, with less emphasis on the implementability and relative cost criteria. Technologies surviving the screening process are those that are expected to achieve the remedial action objectives for the site, either alone or in combination with others.

5.10.1 Technical Memorandum

CDM will prepare a draft remedial alternatives screening memorandum that will document all of the analyses and evaluations described above. This draft memorandum will be submitted to EPA for formal review and comment and will:

- Establish Remedial Action Objectives - Based on existing information, CDM will identify site-specific remedial action objectives that should be developed to protect human health and the environment. The objectives will specify the contaminant(s) and media of concern, the exposure route(s) and receptor(s), and an acceptable contaminant level or range of levels for each exposure route (i.e., preliminary remediation goals).

- Establish General Response Actions - CDM will develop general response actions for each medium of interest by defining contaminant, treatment, excavation, pumping, or other actions, singly or in combination to satisfy remedial action objectives. The response actions will take into account requirements for protectiveness as identified in the remedial action objectives and the chemical and physical characteristics of the site.

- Identify and Screen Applicable Remedial Technologies - CDM will identify and screen technologies based on the general response actions. Hazardous waste treatment technologies will be identified and screened to ensure that only those technologies applicable to the contaminants present, their physical matrix, and other site characteristics will be considered. This screening will be based primarily on a technology's ability to address the contaminants at the site effectively, but will also take into account that technology's implementability and cost. CDM will select representative process options, as appropriate, to carry forward into alternative development and will identify the need for treatability testing for those technologies that are probable candidates for consideration during the detailed analysis.

- Develop Remedial Alternatives in accordance with the National Contingency Plan (NCP).

- Screen Remedial Alternatives for Effectiveness, Implementability, and Cost - CDM will screen alternatives to identify the potential technologies or process options that will be combined into media-specific or site-wide alternatives. The developed alternatives will be defined with respect to size and configuration of the representative process options, time for remediation, rates of flow or treatment, spatial requirements, distances for disposal, required permits, imposed limitations, and other factors necessary to evaluate the alternatives. If many distinct viable options are available and developed, CDM will screen the alternatives undergoing detailed analysis to provide the most promising process options.

The technical evaluations completed as part of this task will be summarized and presented to EPA in a technical meeting.

5.10.2 Final Technical Memorandum

As directed by EPA, this subtask is not applicable. EPA's review comments on the draft technical memorandum will be incorporated into the draft FS report under Section 5.12.1.

5.11 Task 11 - Remedial Alternatives Evaluation

Remedial technologies passing the initial screening process will be grouped into remedial alternatives. This task covers efforts associated with the assessment of individual alternatives against each of the nine current evaluation criteria and a comparative analysis of all options against the evaluation criteria. The analysis will be consistent with the NCP, 40 CFR Part 300, and will consider the *Guidance for Conducting Remedial Investigation and Feasibility Studies under CERCLA* (OSWER Directive 9355.3-01) and other pertinent OSWER guidance. The detailed evaluation criteria for remedial alternatives are listed on Table 5-4 and a brief description of each criterion is provided:

- <u>Overall Protection of Human Health and the Environment</u> - This criterion provides a final check to assess whether each alternative meets the requirement that it is protective of human health and the environment. The overall assessment of protection is based on a composite of factors assessed under the evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

- <u>Compliance with ARARs</u> - This criterion is used to determine how each alternative complies with applicable or relevant and appropriate Federal and State requirements, as defined in Section 121 of CERCLA 42 USC Section 9621.

- Long-Term Effectiveness - This criterion addresses the results of a remedial action in terms of the risk remaining at the site after the response objectives have been met. The primary focus of this evaluation is to determine the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes. The factors to be evaluated include the magnitude of remaining risk (measured by numerical standards such as cancer risk levels), and the adequacy, suitability and long-term reliability of management controls for providing continued protection from residuals (i.e., assessment of potential failure of the technical components).

- Reduction of Toxicity, Mobility, or Volume - This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility or volume of the contaminants. The factors to be evaluated include the treatment process employed, the amount of hazardous material destroyed or treated, the degree of reduction expected in toxicity, mobility or volume, and the type and quantity of treatment residuals.

- Short-Term Effectiveness - This criterion addresses the effects of the alternative during the construction and implementation phase until the remedial actions have been completed and the selected level of protection has been achieved. Each alternative is evaluated with respect to its effects on the community and onsite workers during the remedial action, environmental impacts resulting from implementation, and the amount of time until protection is achieved.

- Implementability - This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. Technical feasibility considers construction and operational difficulties, reliability, ease of undertaking additional remedial action (if required), and the ability to monitor its effectiveness. Administrative feasibility considers activities needed to coordinate with other agencies (e.g., Commonwealth and local) in regard to obtaining permits or approvals for implementing remedial actions.

- Cost - This criterion addresses the capital costs, annual operation and maintenance costs, and present worth analysis. Capital costs consist of direct (construction) and indirect (non-construction and overhead) costs. Direct costs include expenditures for the equipment, labor and material necessary to perform remedial actions. Indirect costs include expenditures for engineering, financial and other services that are not part of actual installation activities but are required to complete the installation of remedial alternatives. Annual operation and maintenance costs are post-construction costs necessary to ensure the continued effectiveness of a remedial action. These costs will be estimated to provide an accuracy of +50 percent to -30 percent. A present worth analysis is used to evaluate expenditures that occur over different time periods by discounting all future costs to a common base year, usually the current year. This allows the cost of remedial action alternatives to be compared on the basis of a single figure representing the amount of money that would be sufficient to cover all costs associated with the remedial action over its planned life.

- Commonwealth Acceptance - This criterion evaluates the technical and administrative issues and concerns the Commonwealth may have regarding each of the alternatives. The factors to be evaluated include those features of alternatives that the Commonwealth supports, reservations of the Commonwealth, and opposition of the Commonwealth.

- Community Acceptance - This criterion incorporates public concerns into the evaluation of the remedial alternatives. Often, community (and also Commonwealth) acceptance cannot be determined during development of the RI/FS. Evaluation of these criteria is postponed until the RI/FS report has been released for state and public review. These criteria are then addressed in the ROD and the responsiveness summary.

Each remedial alternative will be subject to a detailed analysis according to the above evaluation criteria. A comparative analysis of all alternatives will then be performed to evaluate the relative benefits and drawbacks of each according to the same criteria. A preferred remedial alternative will be recommended based upon the results of the comparative analysis.

5.11.1 Technical Memorandum

CDM will prepare a draft technical memorandum that addresses the following:

- A technical description of each alternative that outlines the waste management strategy involved and identifies the key ARARs associated with each alternative.

- A discussion that describes the performance of that alternative with respect to each of the evaluation criteria. A table will be provided summarizing the results of this analysis. Once the individual analysis is completed, a comparison and contrast of the alternatives to one another, with respect to each of the evaluation criteria, will be performed.

This draft memorandum will be submitted to EPA for formal review and comment. In addition, the technical evaluations completed as part of this task will be summarized and presented to EPA in a technical meeting.

5.11.2 Final Technical Memorandum

As directed by EPA, this subtask is not applicable. EPA's review comments on the draft technical memorandum will be incorporated into the draft FS report under Section 5.12.1.

5.12 Task 12 - Feasibility Study Report

CDM will develop a feasibility study report consisting of a detailed analysis of alternatives and a cost-effectiveness analysis, in accordance with the NCP, 40 CFR Part 300, as well as the most recent guidance.

5.12.1 Draft Feasibility Study Report

CDM will submit a draft feasibility study report to EPA that includes the following detailed information.

- Summarize the Remedial Investigation - CDM will summarize key elements of the RI including the nature and extent of contamination in all site media of concern, the fate and transport factors that affect the identified contamination, and the results of the site risk assessments.

- Establish Remedial Action Objectives - Based on existing information, CDM will identify site-specific remedial action objectives that will protect human health and the environment. The objectives will specify the contaminant(s) and media of concern, the exposure route(s) and receptor(s), and an acceptable contaminant level or range of levels for each exposure route (i.e., preliminary remediation goals).

- Establish General Response Actions - CDM will develop general response actions for each medium of interest by defining contaminant, treatment, excavation, pumping, or other actions, singly or in combination, to satisfy remedial action objectives. The response actions will take into account requirements for protectiveness as identified in the remedial action objectives and the chemical and physical characteristics of the site.

- Identify and Screen Applicable Remedial Technologies - CDM will identify and screen technologies based on the general response actions. Hazardous waste treatment technologies will be identified and screened to ensure that only those technologies applicable to the contaminants present, their physical matrix, and other site characteristics will be considered. This screening will be based primarily on a technology's ability to address the contaminants at the site effectively, but will also take into account that technology's implementability and cost. If applicable, CDM will develop an analytical flow model to support groundwater flow and plume capture model of the hydrogeologic system at the site and surrounding area. CDM will select representative process options, as appropriate, to carry forward into alternative development and will identify the need for treatability testing for those technologies that are probable candidates for consideration during the detailed analysis.

- Develop Remedial Alternatives in accordance with the NCP - CDM will assemble technologies into remedial alternatives to address the identified contamination at the site.

- Screen Remedial Alternatives for Effectiveness, implementability, and Cost - CDM will screen alternatives to identify the potential technologies or process options that will be combined into media-specific or site-wide alternatives. The developed alternatives will be defined with respect to size and configuration of the representative process options, time for remediation, rates of flow or treatment, spatial requirements, distances for disposal, required permits, imposed limitations, and other factors necessary to evaluate the alternatives. If many distinct viable options are available and developed, CDM will screen the alternatives undergoing detailed analysis to focus on the most promising process options.

- Develop Detailed Alternative Descriptions - CDM will develop detailed technical descriptions of each alternative that outlines the waste management strategy involved and identifies the key ARARs associated with each alternative.

- Screen Against Evaluation Criteria - CDM will present discussions that describe the performance of each alternative with respect to the evaluation criteria described in Section 5.11. The results of the analysis will be summarized in a table.

- Compare Alternatives - CDM will compare and contrast the alternatives to one another, with respect to each of the evaluation criteria.

The technical feasibility considerations will include the careful study of any problems that may prevent a remedial alternative from mitigating site problems. Therefore, the site characteristics from the RI will be kept in mind as the technical feasibility of the alternative is studied. Specific items to be addressed will be reliability (operation over time), safety, operation and maintenance, ease with which the alternative can be implemented, and time needed for implementation.

The FS report format is shown on Table 5-5 and will consist of an executive summary and five sections. The executive summary will be a brief overview of the FS and the analysis underlying the remedial actions that were evaluated. The five sections will be as follows:

- Introduction and Summary of the Remedial Investigation
- Identification and Screening of Remedial Technologies
- Development and Initial Screening of Remedial Alternatives
- Description and Detailed Analysis of Alternatives
- Comparative Analysis of Alternatives

The FS report will be reviewed by a CDM TRC. TRC comments will be addressed prior to submittal to EPA for review.

5.12.2 Final Feasibility Study Report

Upon receipt of all EPA and other federal and Commonwealth written comments, CDM will prepare a response to comments letter prior to revising the FS report for submittal to EPA. When EPA determines that the document is acceptable, the FS report will be deemed the final FS report.

5.13 Task 13 - Post RI/FS Support

In accordance with the SOW, this task is currently not applicable to this work assignment.

5.14 Task 14 - Negotiation Support

In accordance with the SOW, this task is currently not applicable to this work assignment.

5.15 Task 15 - Administrative Record

In accordance with the SOW, this task is currently not applicable to this work assignment.

5.16 Task 16 - Work Assignment Closeout

Project closeout includes work efforts related to the project completion and closeout phase. Project records will be transferred to EPA. A Work Assignment Closeout Report (WACR) will be completed.

5.16.1 Work Assignment Closeout Report

CDM will prepare a WACR that will include all level-of-effort hours, by professional level, and costs in accordance with the project work breakdown structure.

5.16.2 Document Indexing

CDM will organize the work assignment files in its possession in accordance with the currently approved file index structure.

5.16.3 Document Retention/Conversion

CDM will convert all pertinent paper files into an appropriate long-term storage format. EPA will define the specific long-term storage format prior to closeout of this work assignment.

Section 6
Schedule

A project schedule for the RI/FS is included as Figure 6-1. The project schedule is based on assumptions for durations and conditions of key events occurring on the critical and non-critical path. These assumptions are as follows:

- The schedule for the field activities is dependent on access to all properties being obtained by EPA without difficulty.
- Field activities will not be significantly delayed due to severe weather conditions (i.e., hurricanes).
- The schedule for the field activities is dependent on timely review and approval of the work plan and QAPP and the provision of adequate funding by EPA.
- The schedule for the field investigation is dependent on all field activities being performed in Level D or Level C personal protective equipment (PPE) health and safety protection.
- CDM will receive validated data for analyses performed by EPA's CLP eight weeks after sample collection.

Section 7
Project Management Approach

7.1 Organization and Approach

The proposed project organization is shown in Figure 7-1.

The SM, Mr. Michael Valentino, P.G., has primary responsibility for plan development and implementation of the RI, including coordination with the RI task managers and support staff, development of bid packages for subcontractor services, acquisition of engineering or specialized technical support, and all other aspects of the day-to-day activities associated with the project. The SM identifies staff requirements, directs and monitors site progress, ensures implementation of quality procedures and adherence to applicable codes and regulations, and is responsible for performance within the established budget and schedule.

The RIL, Ms. Nancy Rodriguez, reports to, and will work directly with the SM to develop and coordinate the work plan, QAPP, staffing and physical resource requirements, and technical statements of work for professional subcontractor services. She will be responsible for the implementation of the field investigation, performance tracking of the CDM subcontractor laboratory, the analysis, interpretation and presentation of data acquired relative to the site, preparation of the data evaluation summary report, and the RI report.

The FS task manager, Mr. Brendan MacDonald, will work closely with the RI task manager to ensure that the field investigation generates the proper type and quantity of data for use in the initial screening of remedial technologies/alternatives, detailed evaluation of remedial alternatives, development of requirements for and evaluation of treatability study/pilot testing, if required, and associated cost analysis. The FS report will be developed by the FS technical group.

The field team leader (FTL), Mr. Mike Ehnot, is responsible for on-site management for the duration of all site operations including the activities conducted by CDM such as equipment mobilization, sampling, and the work performed by subcontractors such as surveying.

The RQAC is Ms. Jeniffer Oxford, who is responsible for overall project quality including development of the QAPP, review of specific task QA/QC procedures, and auditing of specific tasks. The RQAC reports to the CDM Quality Assurance Manager (QAM).

The RAC II QAM, Mr. Steven Martz, is responsible for overall quality for the RAC contract, and will have approved quality assurance coordinators (QACs) perform the required elements of the RAC II QA program of specific task QA/QC procedures, and auditing of specific tasks at established intervals. These QACs report to CDM's corporate QA Manager RAC II and are independent of the SM's reporting structure.

The ASC, Mr. Scott Kirchner, will ensure that the subcontract analytical laboratory will perform analyses as described in the QAPP. The ASC provides assistance with meeting EPA sample management and paperwork requirements.

The task numbering system for the RI/FS effort is described in Section 5 of this work plan. Each of these tasks has been scheduled and will be tracked separately during the course of the RI/FS work. For the RAC II contract, the key elements of the monthly progress report will be submitted within 20 calendar days after the end of each reporting period and will consist of a summary of work completed during that period and associated costs.

Project progress meetings will be held, as needed, to evaluate project status, discuss current items of interest, and review major deliverables such as the work plan, QAPP, the data evaluation summary report, the RI report, the human health risk assessment, the SLERA report, and the FS report.

7.2 Quality Assurance and Document Control

All work by CDM on this work assignment will be performed in accordance with the *CDM RAC II Quality Management Plan* (QMP) (CDM 2005).

The RAC II RQAC will maintain QA oversight for the duration of the work assignment. A CDM QAC has reviewed this work plan for QA requirements. A QAPP governing field sampling and analysis is required and will be prepared in accordance with the UFP for QAPPs and current EPA Region II guidance and procedures. It will be submitted to an approved QAC for review and approval before submittal to EPA. Any reports for this work assignment which present measurement data generated during the work assignment will include a QA section addressing the quality of the data and its limitations. Such reports are subject to QA review following technical review. Statements of work for subcontractor services and subcontractor bids and proposals will receive technical and QA review.

The CDM SM is responsible for implementing appropriate QC measures on this work assignment. Such QC responsibilities include:

- Implementing the QC requirements referenced or defined in this work plan and in the QAPP
- Adhering to the CDM RAC Management Information System (RACMIS) document control system
- Organizing and maintaining work assignment files
- Conducting field planning meetings, as needed, in accordance with the RAC II QMP
- Completing measurement and test equipment forms that specify equipment requirements

Technical and QA review requirements as stated in the QMP will be followed on this work assignment.

Document control aspects of the program pertain to controlling and filing documents.

CDM has developed a program filing system that conforms to EPA's requirements to ensure that the documents are properly stored and filed. This guideline will be implemented to control and file all documents associated with this work assignment. The system includes document receipt control procedures, a file review, an inspection system, and file security measures.

The RAC II QA program illustrated on Table 9-1 of the QMP (CDM 2005) includes both self-assessments and independent assessments as checks on quality of data generated on this work assessment. Self assessments include management system audits, trend analyses, calculation checking, data validation, and technical reviews. Independent assessments include office, field and laboratory audits and the submittal of performance evaluation samples to laboratories.

One QA internal system audit and one field technical system audit are required. A laboratory technical system audit may be conducted by the CDM QA staff. Performance audits (i.e., performance evaluation samples) may be administered by CDM as required for any analytical parameters. An audit report will be prepared and distributed to the audited group, to CDM management, and to EPA. EPA may conduct or arrange a system or performance audit.

7.3 Project Coordination

The SM will coordinate all project activities with the EPA RPM. Regular telephone contact will be maintained to provide updates on project status. Field activities at the site will require coordination among federal, Commonwealth, and local agencies and coordination with involved private organizations. Coordination of activities with these stakeholders is described below.

EPA is responsible for overall direction and approval of all activities for the Maunabo site. EPA may designate technical advisors and experts from academia or its technical support branches to assist on the site. Agency advisors could provide important sources of technical information and review, which the CDM team will use from initiation of RI/FS activities through final reporting.

Sources of technical information include EPA, PREQB, PRASA, PRIDCO, USGS, and sampling conducted during previous investigations. These sources can be used for background information on the site and surrounding areas.

The Commonwealth, through PREQB, may provide review, direction, and input during the RI/FS. EPA's RPM will coordinate contact with personnel from other agencies.

Local agencies that may be involved include PRASA, and local departments such as planning boards, zoning and building commissions, police, fire, health departments, and utilities (water and sewer). Contacts with these local agencies will be coordinated through EPA.

Private organizations requiring coordination during the RI/FS include residents in the area and public interest groups such as environmental organizations and the press. Coordination with these interested parties will be performed through EPA.

Section 8
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Section 9
Glossary of Abbreviations

amsl	above mean sea level
ARARs	Applicable or Relevant and Appropriate Requirements
ASC	Analytical Services Coordinator
bgs	below ground surface
BNA	Base/Natural Acids
BOA	basic ordering agreement
CAM	Centro de Acopio Manufacturing
CDM	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
CFR	Code of Federal Regulations
CGE	Caribe General Electric
CIP	Community Involvement Plan
cis-1,2-DCE	cis-1,2-dichloroethene
CLASS	Contract Laboratory Analytical Support Services
CLP	Contract Laboratory Program
CO	Contracting Officer
COPC	chemical of potential concern
COPEC	Contaminant of Potential Ecological Concern
CSM	conceptual site model
CTE	Central Tendency Exposure
DESA	Division of Environmental Science and Assessment
DNAPL	dense non-aqueous phase liquid
DO	dissolved oxygen
DPT	Direct push technology
DQI	Data Quality Indicator
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
Eh	Oxidation-Reduction Potential
EPA	United States Environmental Protection Agency
EPC	Exposure point concentration
EQuIS	Environmental Quality Information Systems
ERAGS	Ecological Risk Assessment Guidance for Superfund
ESAT	Environmental Services Assistance Team
F	Fahrenheit
FASTAC	Field and Analytical Services Teaming Advisory Committee
FEMA	Federal Emergency Management Agency
FS	feasibility study
FTL	Field Team Leader
ft/mi	feet per mile
GIS	Geographic Information System
GS1	Total Gas Station
GS2	Esso Gas Station

gpm	gallons per minute
HEAs	Health Effects Assessment
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HI	Hazard Index
HPFA	High Priority for Further Action
HQ	Hazard Quotient
HRS	Hazard Ranking System
HSA	Hollow Steam Auger
HSP	Health and Safety Plan
ID	identification
IDW	Investigation Derived Waste
IFB	Invitation For Bid
IRIS	Integrated Risk Information System
JUA	Juan Orozco Limited
kg	kilogram
L	liter
LD_{50}	median lethal dose
LDL	Low detection limit
LEL	Lowest effects level
LOAEL	Lowest observed adverse effect level
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MDL	Method detection limit
mg	milligram
mg/kg	milligrams per kilogram
MNA	monitored natural attenuation
MTBE	methyltertbutylether
NCP	National Contingency Plan
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No observed adverse effect level
NPDES	National Pollution Discharge Elimination System
NPL	National Priority List
OSWER	Office of Solid Waste and Emergency Response
PAR	Pathway Analysis Report
PA/SI	Preliminary Assessment/Site Inspection
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene
PHP	Plastic Home Products
PID	photoionization detector
PLOE	professional level of effort
PO	Project Officer
POTW	Publically Owned Treatment Works
ppb	parts per billion
PPE	personal protective equipment
PPRTV	Provisional Peer Reviewed Toxicity Values

PRASA	Puerto Rico Aqueduct and Sewer Authority
PRB	Puerto Rico Beverage
PRDOH	Puerto Rico Department of Health
PREQB	Puerto Rico Environmental Quality Board
PRGs	Preliminary Remediation Goals
PRIDCO	Puerto Rico Industrial Development Corporation
QA/QC	quality assurance/quality control
QAC	Quality Assurance Coordinator
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QMP	Quality Management Plan
RA	risk assessment
RAC	Response Action Contract
RACMIS	RAC Management Information System
RAGS	Risk Assessment Guidance for Superfund
RAS	Routine Analytical Services
RCRA	Resource Conservation and Recovery Act
RfC	reference concentration
RfD	reference dose
RFP	request for proposal
RIL	remedial investigation leader
RI/FS	remedial investigation/feasibility study
RME	reasonable maximum exposure
ROD	Record of Decision
RPM	Remedial Project Manager
RQAC	Regional Quality Assurance Coordinator
RSCC	Regional Sample Control Center
SARA	Superfund Amendments and Reauthorization Act of 1986
SAT 2	Site Assessment Team 2
SEL	severe effects limit
SF	Storage Facility
SLERA	Screening Level Ecological Risk Assessment
SM	site manager
SMO	Sample Management Office
SOP	Standard Operating Procedures
SOW	Statement of Work
SQL	sample quantitation limit
SS	Senior Scientist
SSL	Soil Screening Level
STSC	Superfund Health Risk Technical Support Center
SVOC	semi-volatile organic compound
T	Transect
TAL	Target Analyte List
TBC	"To Be Considered"
TCE	trichloroethene
TCL	Target Compound List
TDS	Total dissolved solids

The site	Maunabo Groundwater Contamination Site
TKN	total Kjehldahl nitrogen
TOC	total organic carbon
TOM	Technical Operations Manager
TRC	Technical Review Committee
TSS	total suspended solids
TSCA	Toxic Substances Control Act
UCL	Upper Confidence Limit
UFP	Uniform Federal Policy
μg/L	micrograms/liter
USC	United States Code
USGS	United States Geological Survey
VOC	volatile organic compound
WACR	Work Assignment Close-Out Report
1,1-DCE	1,1-dichloroethylene
1,2-DCE	1,2-dichloroethylene

Table 2-1
PRASA Water Quality Data (1998-2004) Primary VOCs Detected
Maunabo Urbano Public Water System
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

YEAR	PCE			TCE			1,1 DCE			cis 1-2 DCE		
	MCL	Result	Min-Max	MCL	Result	Min-Max	MCL	Result	Min-Max	MCL	Result	Min-Max
1998	5	*	*	5	*	*	7	1	ND-2.2	70	*	*
1999	5	*	*	5	*	*	7	0.8	ND-2.5	70	*	*
2000	5	*	*	5	*	*	7	0.9	ND-2.2	70	*	*
2001	5	1	N/A	5	0.7	N/A	7	0.6	ND-0.9	70	3.9	N/A
2002	5	7.5	0.5-16.4	5	0.8	0.5-1.4	7	1.2	0.5-9.0	70	3.0	0.5-4.1
2003	5	4	ND-4.5	5	0.6	0.5-1.0	7	0.6	ND-1	70	2.2	ND-4.1
2004	5	1.8	ND-9.6	5	0.62	ND-0.8	7	0.73	ND-1.5	70	0.8	ND-2.6

Notes:
Data obtained from PRASA Water Quality Reports 1998-2004.
Report indicates that the 2002 PCE MCL exceedance is from Maunabo 1.
Maunabo 1: not in operation 1998-2000.
Number of samples collected not specified in the report.
Results reported represent the average of the samples collected for that year.
Data reported in ug/L.
N/A: Not applicable.
ND: Not Detected
MCL: Maximum Contaminant Level
PCE: Tetrachloroethylene
TCE: Trichloroethylene
DCE: Dichloroethylene
* : Data not available

Table 2-2
EPA December 2005 Sampling Summary
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

Facility Name	Facility Description	Former Site Uses	Number of Surface Soil Samples	Number of Subsurface Soil Samples	Number of Groundwater Samples	Results
Centro de Acopio Manufacturing	Storage of agricultural equipment.	Prefabricated piping in frame walls, plantain products, and storage of lubricant oil.	4	2	1	"Non-detect" values for the chlorinated solvents detected in the Maunabo system.
Juan Orozco Limited, Inc.	Manufacture of guitars, guitar cases, and guitar strings.	Former site use not available.	4	3 (includes 1 dup)	1	"Non-detect" values for the chlorinated solvents detected in the Maunabo system.
Puerto Rico Beverage	Distribution of Fruit-based beverages.	Bedroom furniture and plastic filter manufacturing, emergency shelter (after a hurricane) and parking for the municipality. Hazardous substances used includes: sodium hydroxide, nitric acid, potassium hydroxide, and ethylene glycol.	4	2	1	"Non-detect" values for the chlorinated solvents detected in the Maunabo system.
Plastic Home Products	Manufacture of domestic plastic products.	Furniture manufacturing, storage of emergency supplies for hurricane response.	4	2	Groundwater not encountered.	"Non-detect" values for the chlorinated solvents detected in the Maunabo system.

Table 2-2
EPA December 2005 Sampling Summary
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

Facility Name	Facility Description	Former Site Uses	Number of Surface Soil Samples	Number of Subsurface Soil Samples	Number of Groundwater Samples	Results
Storage Facility	Operated by Federal Emergency Management Agency (FEMA) for storage of emergency supplies intended primarily for hurricane response.	Operated by CGE for the manufacture of high voltage contactors and resistors.	5 (includes 1 dup)	2	Groundwater not encountered.	"Non-detect" values for the chlorinated solvents detected in the Maunabo system. Future investigation recommended due to hazardous waste generated at the site during Caribe General Electric (CGE) operations.ite use not available.
Total Gas Station (GS1)	Facility abandoned and vacant.	Gas Station.	0	0	2	"Non-detect" values for the chlorinated solvents detected in the Maunabo system. Methyltertbutylether (MTBE) was detected at 14 and 7J* micrograms/liter (ug/L) in the groundwater samples collected at Gas Station (GS) 1. Benzene was also detected at GS 1 at 4J and 20 ug/L, which is above the maximum contaminant level (MCL) of 5 ug/L.
Esso Gas Station (GS2)	Gas Station.	Former site use not available.	0	0	3 (includes 1 dup)	"Non-detect" values for the chlorinated solvents detected in the Maunabo system.
Waste Water Treatment Plant (WWTP)	Puerto Rico Aqueduct and Sewer Authority (PRASA) WWTP.	Former site use not available.	4	2	1	"Non-detect" values for the chlorinated solvents detected in the Maunabo system.

Table 2-2
EPA December 2005 Sampling Summary
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

Facility Name	Facility Description	Former Site Uses	Number of Surface Soil Samples	Number of Subsurface Soil Samples	Number of Groundwater Samples	Results
Maunabo Landfill	Facility currently accepts "sludge".	Landfill.	4 (includes 1 dup)	1	1	"Non-detect" values for the chlorinated solvents detected in the Maunabo system.
El Negro Auto Part	Auto parts distributor and auto repair facility.	Former site use not available.	1	0	0	"Non-detect" values for the chlorinated solvents detected in the Maunabo system.
Background	NA (Not applicable)	NA	4	2	1	"Non-detect" values for the chlorinated solvents detected in the Maunabo system.

* Note: The J qualifier denotes that the identification of the analyte is acceptable and the reported value is an estimate.

Table 4-1
Summary of Data Quality Levels
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

Data Uses	Analytical Level (1)	Types of Analysis
Site characterization monitoring during implementation	Screening level with definitive level confirmation	- Total organic vapor using instruments - Water quality field measurements using portable instruments
Risk assessment Site Characterization Monitoring during implementation	Definitive level	- Organics/Inorganics using EPA-approved methods - CLP SOWs - Standard water analyses - Analyses performed by laboratory
Site characterization	DQO level Field instrument (2)	- Measurements from field equipment - Qualitative measurements

(1) Definitions of analytical levels: Screening data are generated by rapid, less precise methods of analysis with less rigorous sample preparation. Screening data provide analyte (or at least chemical class) identification and quantification, although the quantification may be relatively imprecise. For definitive confirmation, approximately 10 percent of the screening data are confirmed using analytical methods and quality control procedures and criteria associated with definitive data. Screening data without associated confirmation data are generally not considered to be data of known quality.

Definitive data are generated using rigorous analytical methods, such as EPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods generating definitive data produce tangible raw data (e.g., chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files. Data may be generated at the site or at an off-site location, as long as the quality control requirements are satisfied. For the data to be definitive, either analytical or total measurement error must be determined.

(2) DQO = Measurement-specific Data Quality Objective requirements will be defined in the QAPP.

Table 5-1
Summary of Sampling and Analysis Program
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

Sample Locations	Sample Matrix	Field Parameters	CLP Analytical Parameters	DESA or Subcontract Lab Analytical Parameters	Number of Samples (1)	Sample Frequency/Intervals
Groundwater Screening Samples (Geoprobe™)						
Transect 1	GW	DO, Eh, Turb, pH, Cond, Temp	NA	VOCs (<1 ug/L) (24-hour turnaround)	130	Sample every 10 feet
Transect 2	GW	DO, Eh, Turb, pH, Cond, Temp	NA	VOCs (<1 ug/L) (24-hour turnaround)	65	Sample every 10 feet
Transect 3	GW	DO, Eh, Turb, pH, Cond, Temp	NA	VOCs (<1 ug/L) (24-hour turnaround)	35	Samples every 10 feet
Transect 4	GW	DO, Eh, Turb, pH, Cond, Temp	NA	VOCs (<1 ug/L) (24-hour turnaround)	52	Samples every 10 feet
Contingent	GW	DO, Eh, Turb, pH, Cond, Temp	NA	VOCs (<1 ug/L) (24-hour turnaround)	52	Samples every 10 feet
Soil Samples (Geoprobe™)						
Surface Soil	Soil	NA	Full TCL/TAL	TOC, pH, Grain Size (50% of samples)	6	1 sample per location (0 to 1 foot bgs)
Soil Borings	Soil	NA	Full TCL/TAL	TOC, pH, Grain Size (50% of samples)	18	6 boreholes 3 samples per borehole
Monitoring Well Samples (Shallow and Deep Wells) - Round 1 and Round 2						
Groundwater Sampling - Rounds 1 and 2	GW	DO, Eh, Turb, pH, Cond, Temp, ferrous iron	Trace VOCs, TCL SVOCs and P/PCBs, TAL metals, cyanide	Chloride, methane, ethane, ethene, nitrate, nitrite, sulfate, sulfide, TOC, TDS, TSS, alkalinity, ammonia, hardness, and TKN	32	16 wells installed 2 sampling rounds

Table 5-1
Summary of Sampling and Analysis Program
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

Sample Locations	Sample Matrix	Field Parameters	CLP Analytical Parameters	DESA or Subcontract Lab Analytical Parameters	Number of Samples (1)	Sample Frequency/Intervals
Monitoring Well Samples - Bedrock Monitoring Wells - FEMA - Round 1 and Round 2						
Groundwater Sampling - Rounds 1 and 2	GW	DO, Eh, Turb, pH, Cond, Temp, ferrous iron	Trace VOCs, TCL SVOCs and P/PCBs, TAL metals, cyanide	chloride, methane. ethane, ethene, nitrate, nitrite, sulfate, sulfide, TOC, TDS, TSS, alkalinity, ammonia, hardness, and TKN	6	3 wells installed 2 sampling rounds
Monitoring Well Samples - Maunabo Public Supply Wells - Round 1 and Round 2						
Groundwater Sampling - Rounds 1 and 2	GW	DO, Eh, Turb, pH, Cond, Temp, ferrous iron	Trace VOCs, TCL SVOCs and P/PCBs, TAL metals. cyanide	chloride, methane, ethane, ethene, nitrate, nitrite, sulfate, sulfide, TOC, TDS, TSS, alkalinity, ammonia, hardness, and TKN	8	4 supply wells 2 sampling rounds
Surface Water and Sediment Samples						
Surface Water	SW	DO, Eh, Turb, pH, Cond	Trace VOCs. TCL SVOCs and P/PCBs, TAL metals, cyanide	chloride, nitrate, nitrite, sulfate, sulfide, TOC, TDS, TSS, alkalinity, ammonia, hardness, and TKN	7	1 sample per location
Sediment	SD	NA	Full TCL/TAL	pH, TOC, grain size	7	1 sample per location
Vapor Intrusion Samples						
Air Sampling	Air	NA	Selected VOCs based on groundwater screening and monitoring well data	NA	13	4 resident/building locations 1 initial sub-slab sample per location 1 concurrent sub-slab and 1 indoor air sample per location 1 background ambient air

Table 5-1
Summary of Sampling and Analysis Program
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

Sample Locations	Sample Matrix	Field Parameters	CLP Analytical Parameters	DESA or Subcontract Lab Analytical Parameters	Number of Samples (1)	Sample Frequency/Intervals
Streambed Groundwater Seepage Samples						
Groundwater Seepage Sampling	GW	DO, Eh, Turb, pH, Cond	TCL SVOCs and P/PCBs, TAL metals, cyanide	Trace VOCs - Diffusion Bags, chloride, nitrate, nitrite, sulfate, sulfide, TOC, TDS, TSS, alkalinity, ammonia, hardness, and TKN	5	1 sample per temporary piezometer

Notes:
(1) environmental samples only

Abbreviations:
bgs = below ground surface
CLP= Contract Laboratory Program
Cond = conductivity
DESA= Division of Environmental Science and Assessment
DO = dissolved oxygen
Eh = oxidation-reduction potential
GW = groundwater
NA = not applicable
P/PCB = pesticides/polychlorinated biphenyl
SD = sediment
SVOC = semivolatile organic compound
SW = surface water
TAL = Target Analyte List
TCL = Target Compound List
TDS = total dissolved solids
Temp = temperature
TKN = total Kjeldahl nitrogen
TOC = total organic carbon
TSS = total suspended solids
Turb = turbidity
VOC = volatile organic compound
ug/L = micrograms per liter
< = less than

Table 5-2
Summary of Groundwater Screening Samples
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

Transect Number	Total Depth (Est. in ft bgs)	Number of Locations	Boring Footage	Sampling Interval (ft)+	Samples per Location **	Total Samples*
Transect No. 1	130	10 ~~12~~	NA	NA	NA	NA
8 locations at 10 ft intervals	130	6 ~~8~~	780 ~~1040~~	10	13	78 ~~104~~
4 locations at 20 ft intervals	130	4 4	520	20	7	28
Transect No. 2	130	5	650	10	13	65
Transect No. 3	70	5	350	10	7	35
Transect No. 4	130	4	520	10	13	52
Contingency Locations	130	4	520	10	13	52
Totals			2340 ~~3600~~			310 ~~336~~

* All samples to be analyzed for VOCs using 24-hour TAT - analytical method quantitation limit of 1 ppb for VOCs

** Include samples at top of water table and bottom of borehole

\+ Samples will be collected from the bottom of the boring moving upward toward the water table

ft- feet

bgs - below ground surface

6 × 4

Table 5-3
Proposed RI Report Format
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

1.0 Introduction
- 1.1 Purpose of Report
- 1.2 Site Background
  - 1.2.1 Site Description
  - 1.2.2 Site History
  - 1.2.3 Previous Investigations
- 1.3 Report Organization

2.0 Study Area Investigation
- 2.1 Surface Features (aerial photos, etc.) (natural and manmade features)
- 2.2 Groundwater Screening Investigation
- 2.3 Contaminant Source Investigations
- 2.4 Meteorological Investigations
- 2.5 Geological Investigations
- 2.6 Groundwater Investigation
- 2.7 Groundwater/Surface Water Interaction Investigation
- 2.8 Human Population Surveys
- 2.9 Ecological Investigation

3.0 Physical Characteristics of Site
- 3.1 Topography
- 3.2 Meteorology
- 3.3 Geology
- 3.5 Hydrogeology
- 3.6 Air Quality
- 3.7 Demographics and Land Use

4.0 Nature and Extent of Contamination
- 4.1 Sources of Contamination
- 4.2 Groundwater
- 4.3 Soil
- 4.4 Surface Water/Sediment

5.0 Contaminant Fate and Transport
- 5.1 Routes of Migration
- 5.2 Contaminant Persistence
- 5.3 Contaminant Migration

Table 5-3
Proposed RI Report Format
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

- 6.0 Baseline Risk Assessment
  - 6.1 Human Health Evaluation
    - 6.1.1 Summary of Data Collection and Evaluation
    - 6.1.2 Exposure Assessment
    - 6.1.3 Toxicity Assessment
    - 6.1.4 Risk Characterization
    - 6.1.5 Uncertainty Assessment
  - 6.2 Ecological Evaluation
    - 6.2.1 Screening Level Ecological Risk Assessment
    - 6.2.2 Ecological Risk Assessment

- 7.0 Summary and Conclusions
  - 7.1 Source(s) of Contamination
  - 7.2 Nature and Extent of Contamination
  - 7.3 Fate and Transport
  - 7.4 Risk Assessments
  - 7.5 Data Limitations and Recommendations for Future Work
  - 7.6 Recommended Remedial Action Objectives

Appendices:
Analytical Data/QA/QC Evaluation Results
Boring Logs
Data

Table 5-4
Detailed Evaluation Criteria for Remedial Alternatives
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

- SHORT-TERM EFFECTIVENESS
  - Protection of community during remedial action
  - Protection of workers during remedial actions
  - Time until remedial response objectives are achieved
  - Environmental impacts

- LONG-TERM EFFECTIVENESS
  - Magnitude of risk remaining at the site after the response objectives have been met
  - Adequacy of controls
  - Reliability of controls

- REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT
  - Treatment process and remedy
  - Amount of hazardous material destroyed or treated
  - Reduction in toxicity, mobility or volume of the contaminants
  - Irreversibility of the treatment
  - Type and quantity of treatment residuals

- IMPLEMENTABILITY
  - Ability to construct technology
  - Reliability of technology
  - Ease of undertaking additional remedial action, if necessary
  - Monitoring considerations
  - Coordination with other agencies
  - Availability of treatment, storage capacity, and disposal services
  - Availability of necessary equipment and specialists
  - Availability of prospective technologies

- COST
  - Capital costs
  - Annual operating and maintenance costs
  - Present worth
  - Sensitivity Analysis

Table 5-4
Detailed Evaluation Criteria for Remedial Alternatives
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

- COMPLIANCE WITH ARARs
  - Compliance with chemical-specific ARARs
  - Compliance with action-specific ARARs
  - Compliance with location-specific ARARs
  - Compliance with appropriate criteria, advisories and guidance
- OVERALL PROTECTION OF HUMAN HEALTH AND ENVIRONMENT
- STATE ACCEPTANCE
- COMMUNITY ACCEPTANCE

Table 5-5
Proposed FS Report Format
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

1.0 Introduction and Summary of Remedial Investigation
- 1.1 Purpose and Organization of Report
- 1.2 Site Description and History
- 1.3 Summary of Remedial Investigation
  - 1.3.1 Source(s) of Contamination
  - 1.3.2 Nature and Extent of Contamination
  - 1.3.3 Contaminant Fate and Transport
  - 1.3.4 Risk Assessment Summaries

2.0 Identification and Screening of Remedial Technologies
- 2.1 Remedial Action Objectives
  - Contaminants of Interest
  - Allowable Exposure Based on Risk Assessment
  - Allowable Exposure Based on ARARs
  - Development of Remedial Action Objectives
- 2.2 General Response Actions
  - Volumes
  - Containment
  - Technologies
- 2.3 Screening of Technology and Process Options
  - 2.3.1 Description of Technologies
  - 2.3.2 Evaluation of Technologies
  - 2.3.3 Screening of Alternatives
  - Effectiveness
  - Implementability
  - Cost

3.0 Development and Initial Screening of Remedial Alternatives
- 3.1 Development of Alternatives
- 3.2 Screening of Alternatives
  - 3.2.1 Alternative 1
  - 3.2.2 Alternative 2
  - 3.2.3 Alternative 3

4.0 Description and Detailed Analysis of Alternatives
- 4.1 Description of Evaluation Criteria
  - Short-Term Effectiveness
  - Long-Term Effectiveness and Permanence
  - Implementability
  - Reduction of Mobility, Toxicity, or Volume Through Treatment
  - Compliance with ARARs
  - Overall Protection
  - Cost
  - State Acceptance
  - Community Acceptance

Table 5-5
Proposed FS Report Format
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

C:\IMS\GIS\Maunabo\GIS_projects\public_supply_wells.mxd

Figure 1-1
Site Location Map
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

C:\IMS\GIS\Maunabo\GIS_projects\site_map.mxd

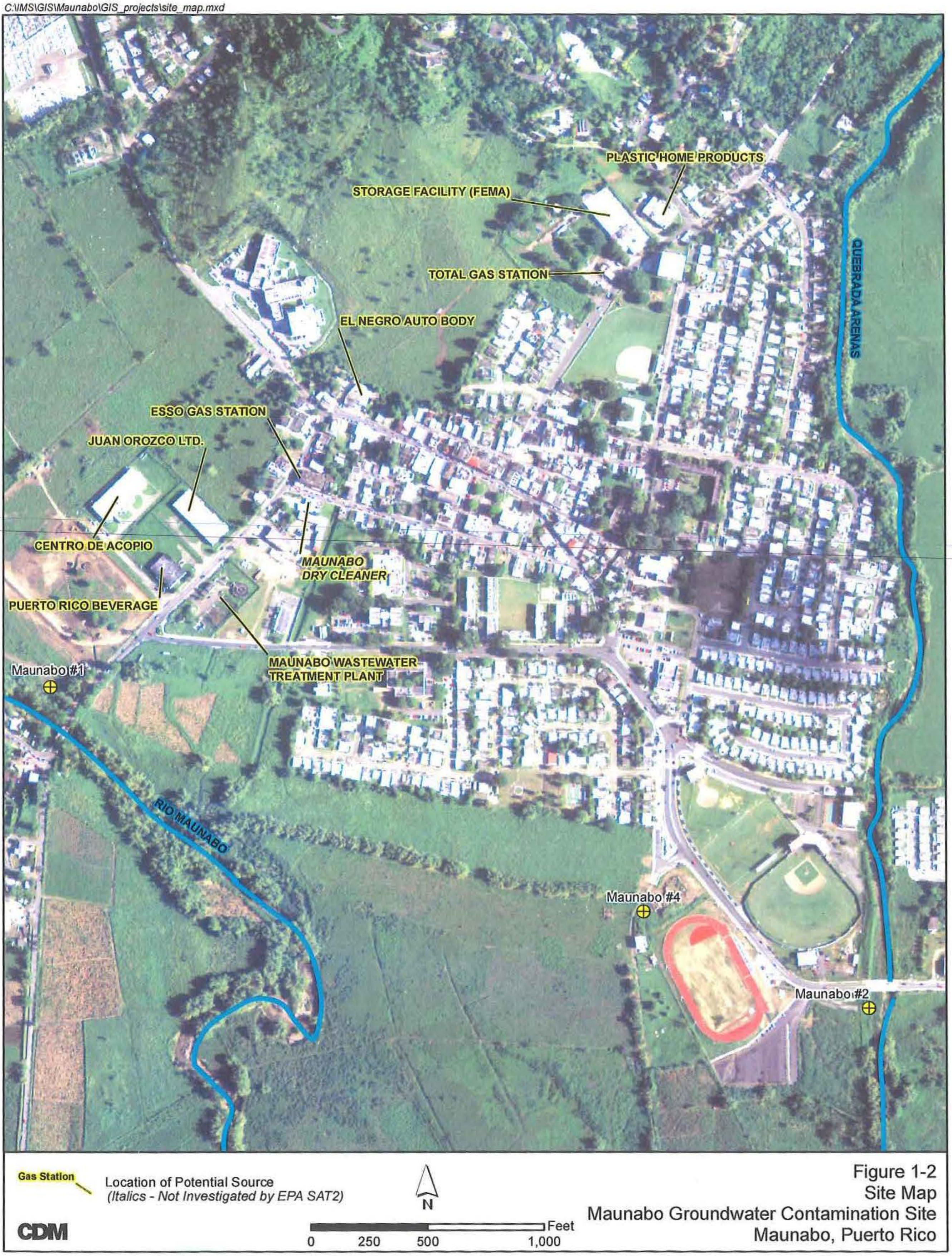


Figure 1-2
Site Map
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

C:\IMS\GIS\Maunabo\GIS_projects\public_supply_wells.mxd

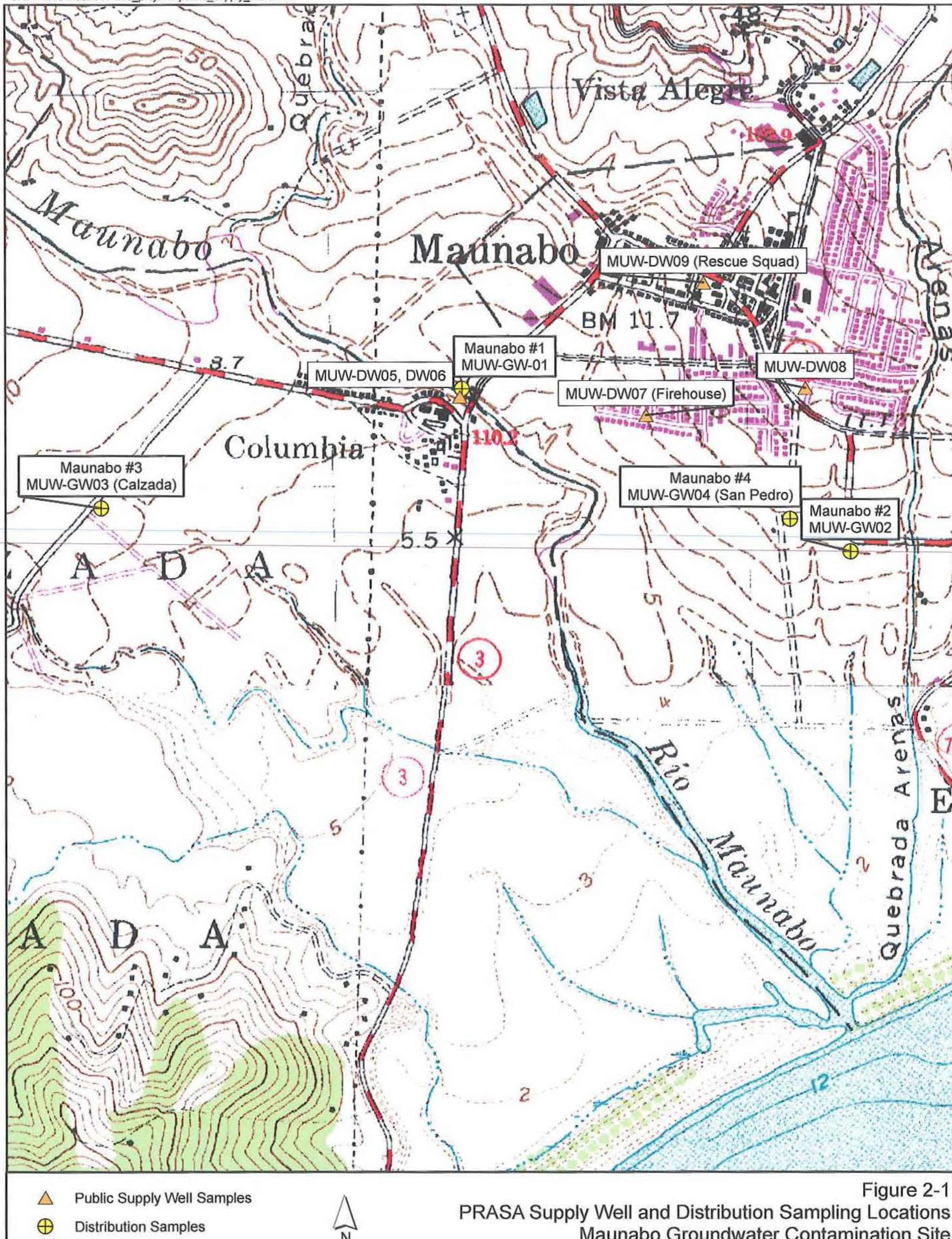


Figure 2-1
PRASA Supply Well and Distribution Sampling Locations
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

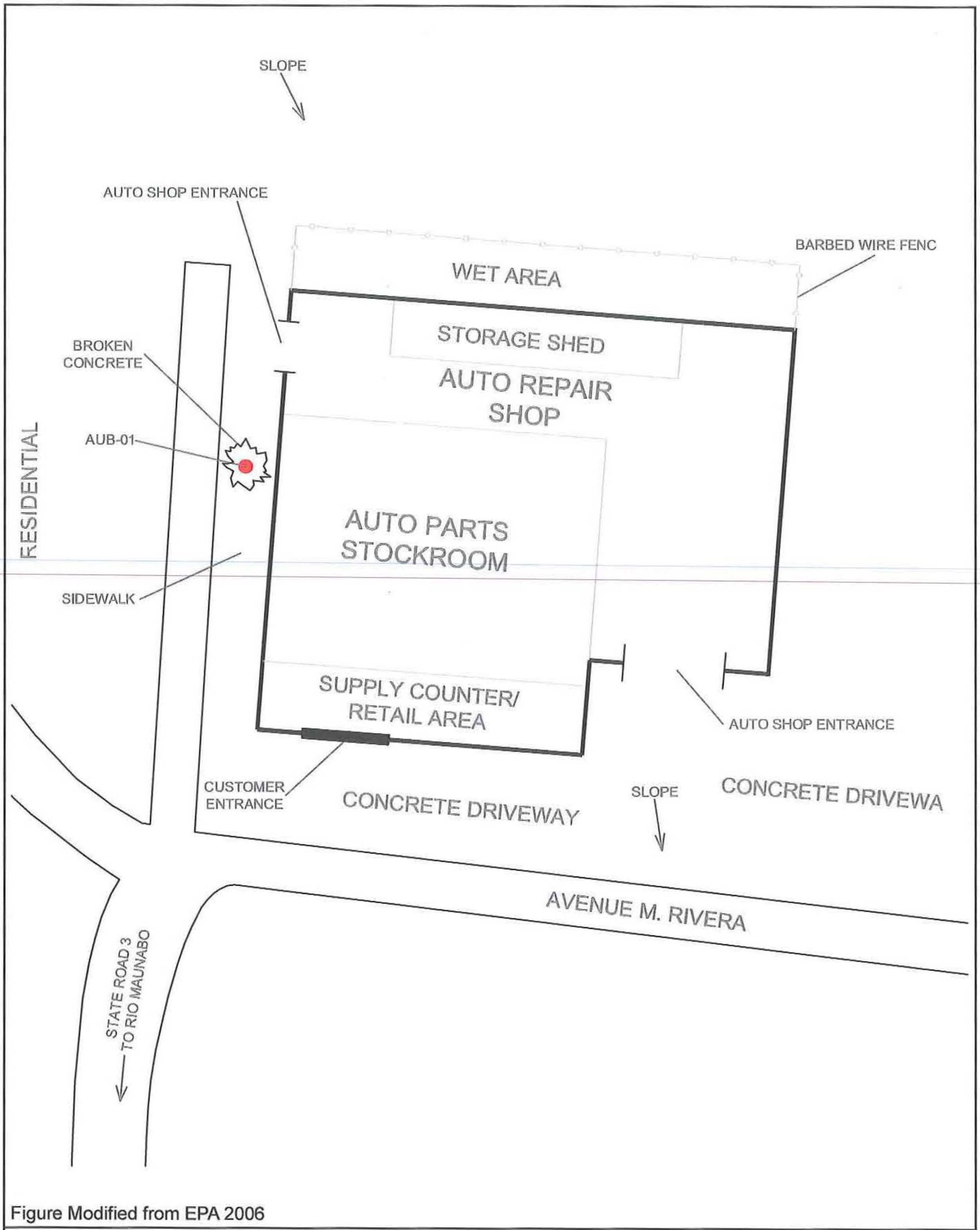


Figure 2-2
EPA SAT 2 Sample Location Map - El Negro Auto Body/Parts
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

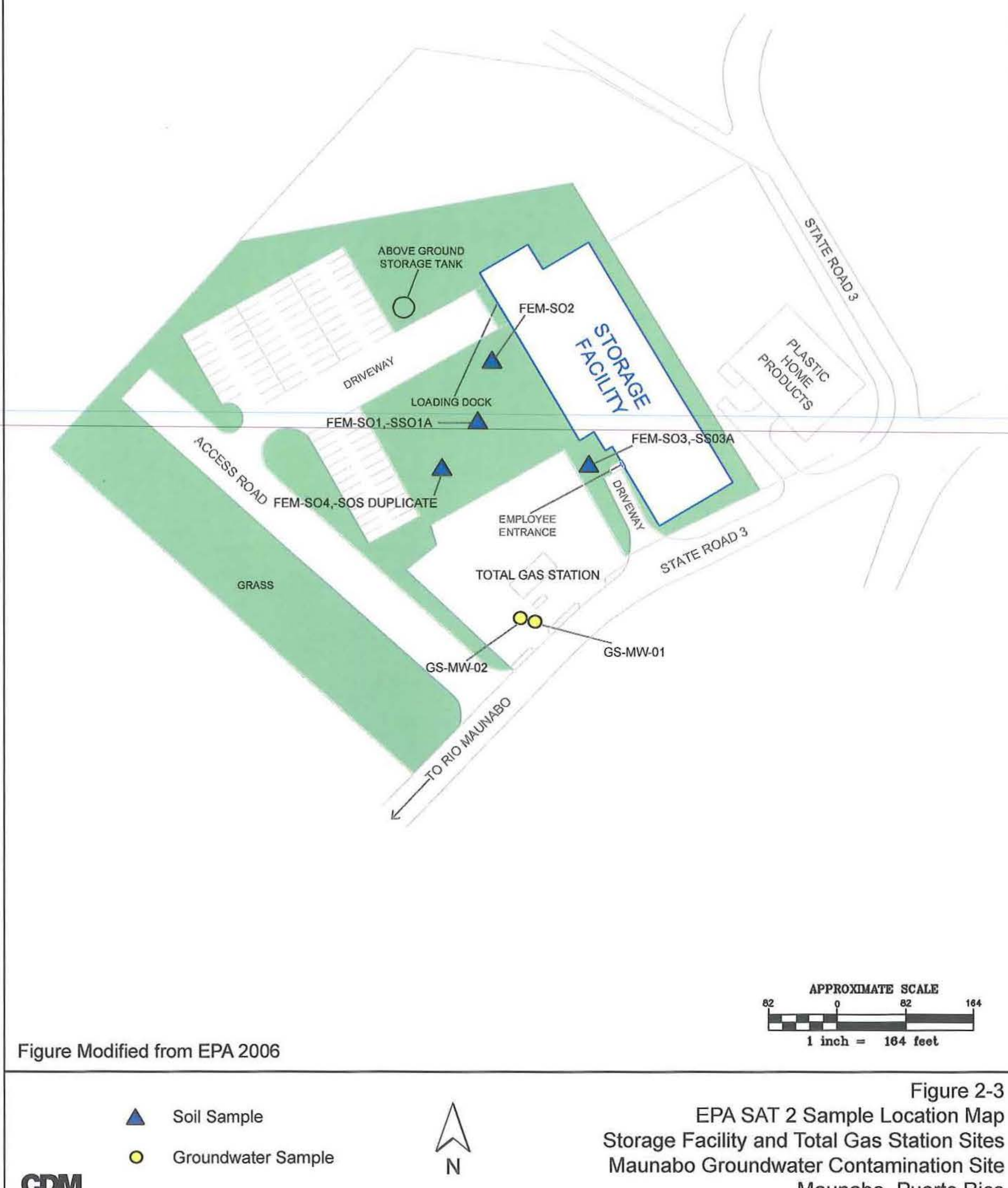


Figure Modified from EPA 2006

Figure 2-3
EPA SAT 2 Sample Location Map
Storage Facility and Total Gas Station Sites
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

Figure Modified from EPA 2006

Figure 2-4
EPA SAT 2 Sample Location Map -
Centro de Acopio Manufacturing
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

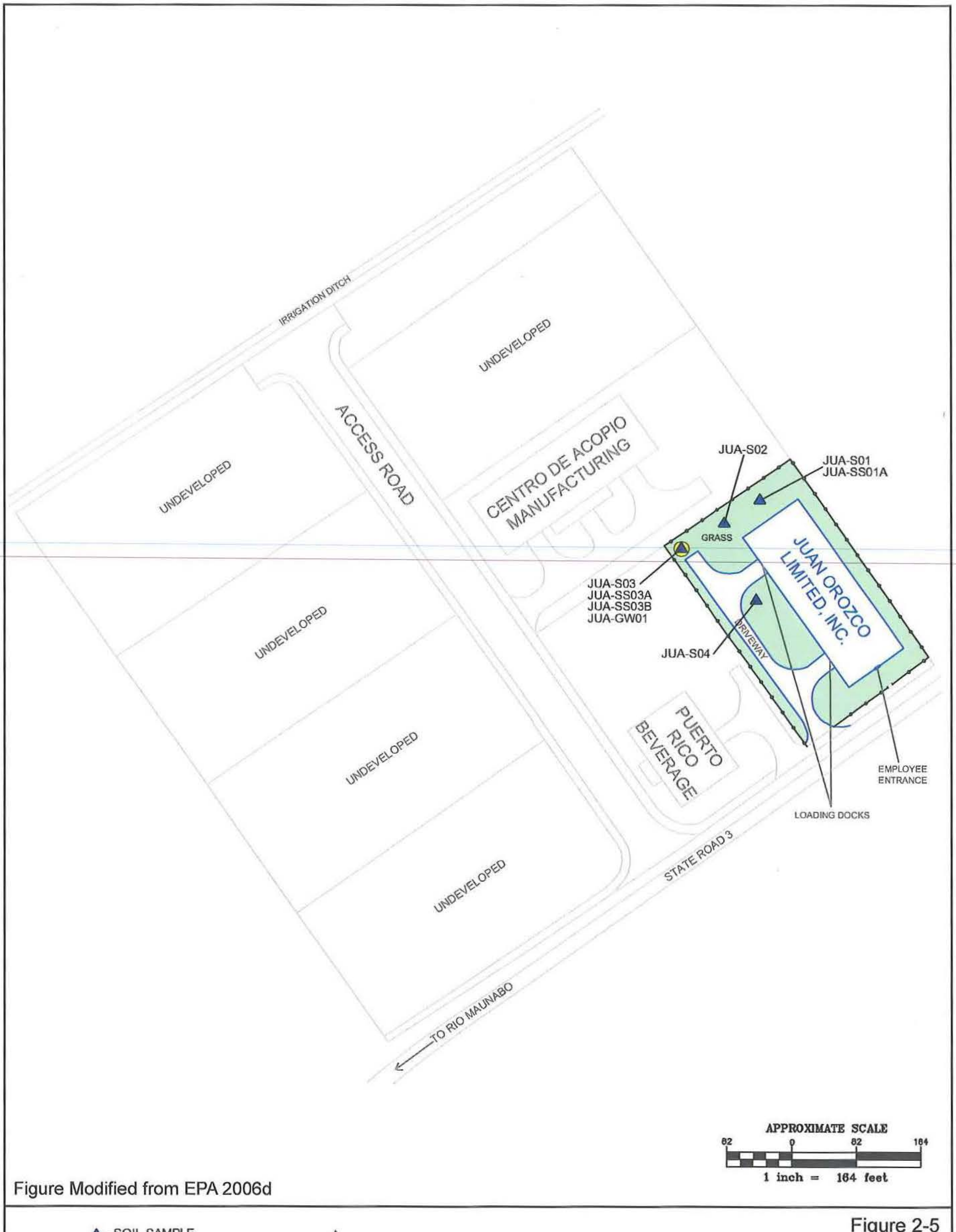


Figure 2-5
EPA SAT 2 Sample Location Map - Juan Orozco Limited, Inc.
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

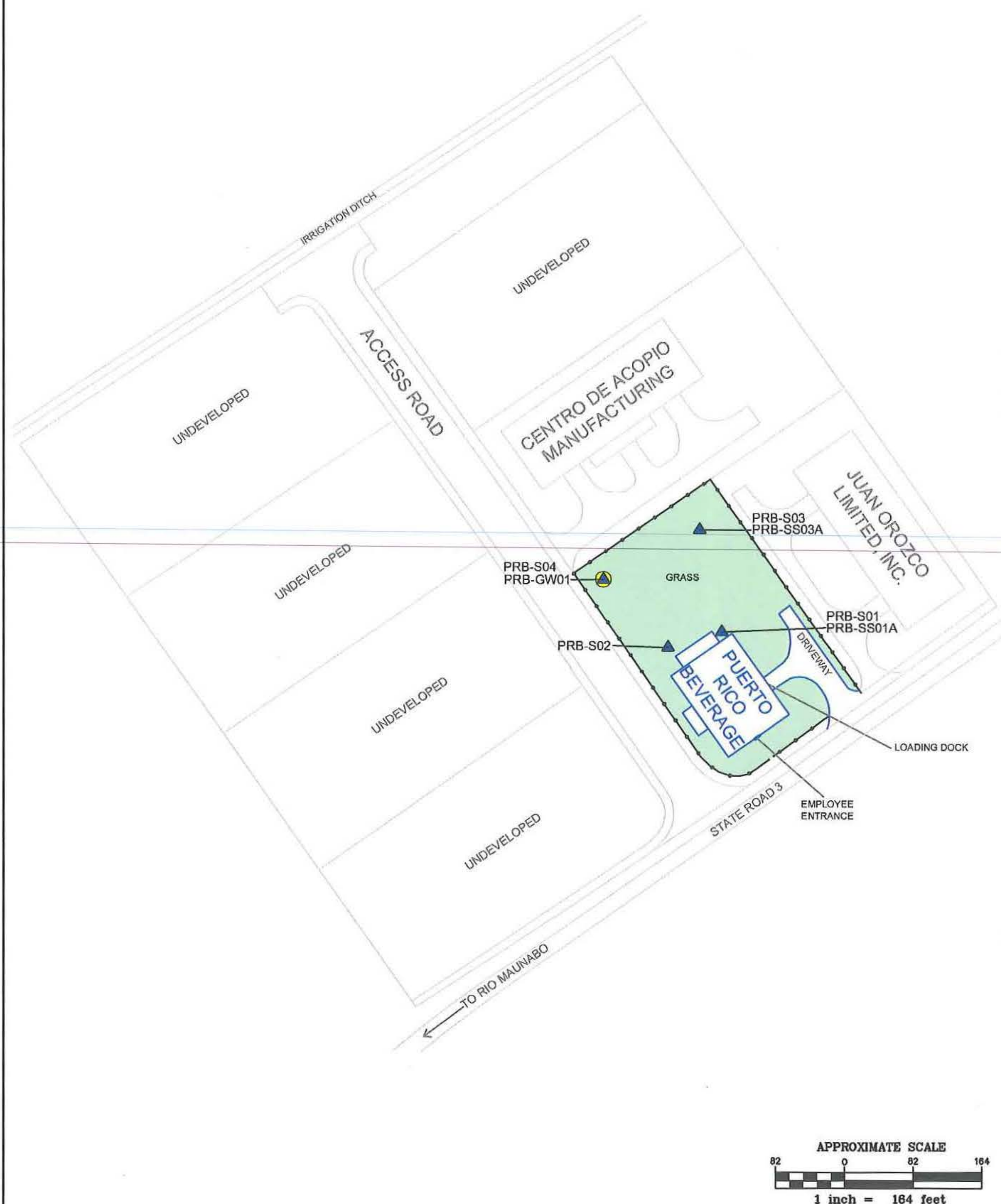


Figure Modified from EPA 2006

▲ - SOIL SAMPLE

○ - GROUNDWATER SAMPLE

N

CDM

Figure 2-6
EPA SAT 2 Sample Location Map - Puerto Rico Beverage
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

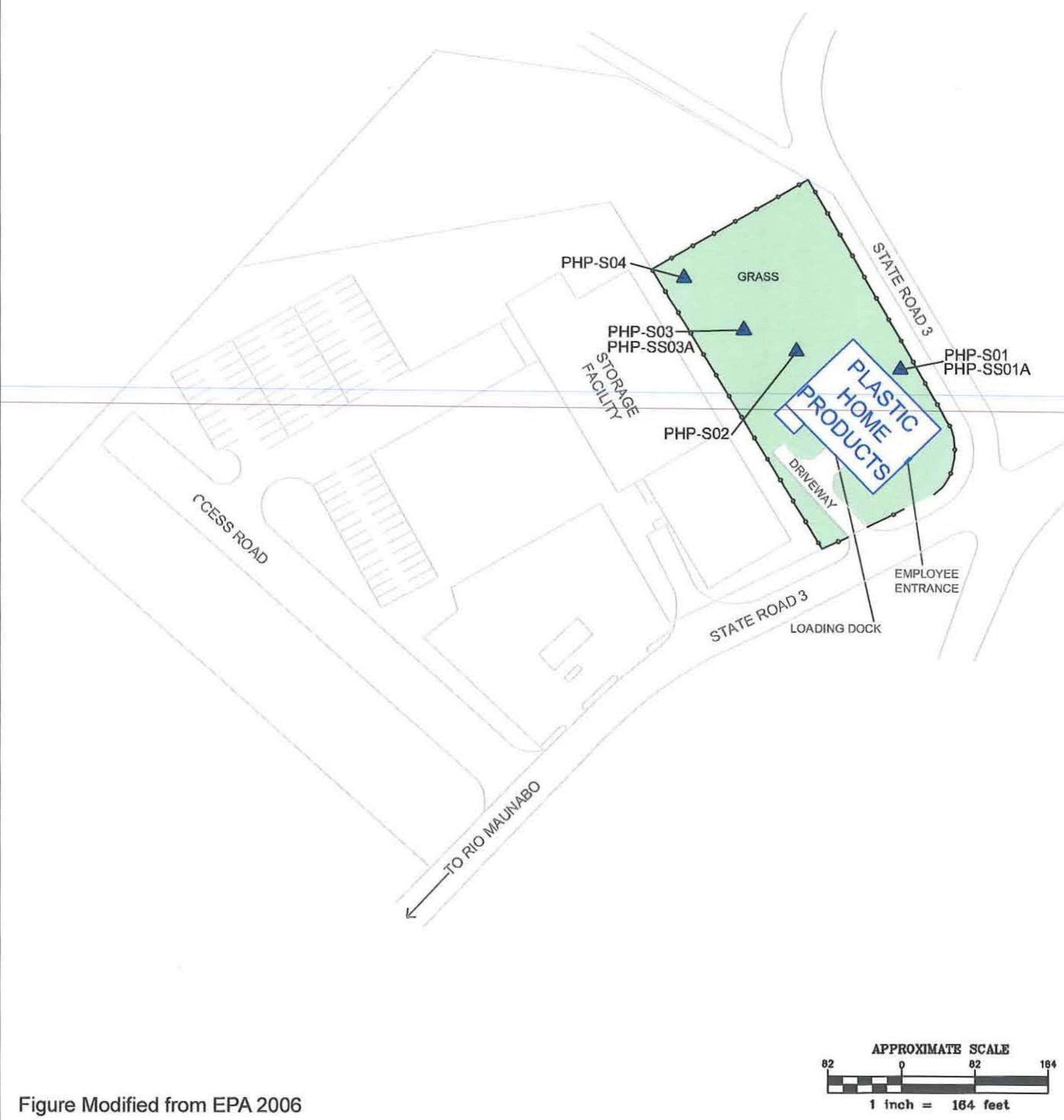


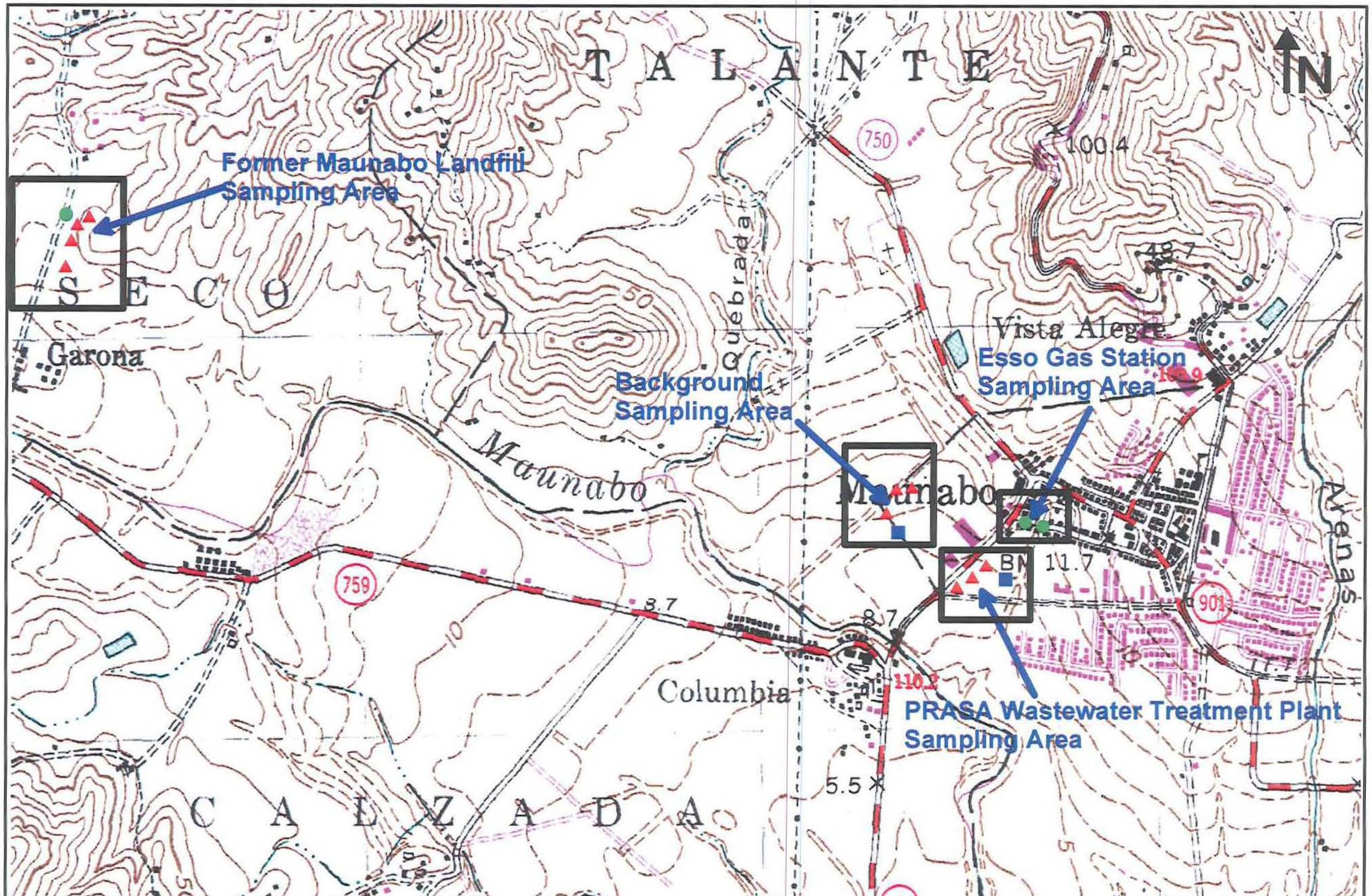
Figure Modified from EPA 2006

▲ - SOIL SAMPLE

CDM

N

Figure 2-7
EPA SAT 2 Sample Location Map - Plastic Home Products
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico



Legend

- ▲ Soil Sample
- ● Groundwater Sample
- ■ Soil and Groundwater Samples

Approximate Scale
1000 Feet

Figure 2-8
EPA SAT 2 Sample Location Map - Non PA/SI Facilities
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

CDM

Figure 3-1
Site Vicinity Geology
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

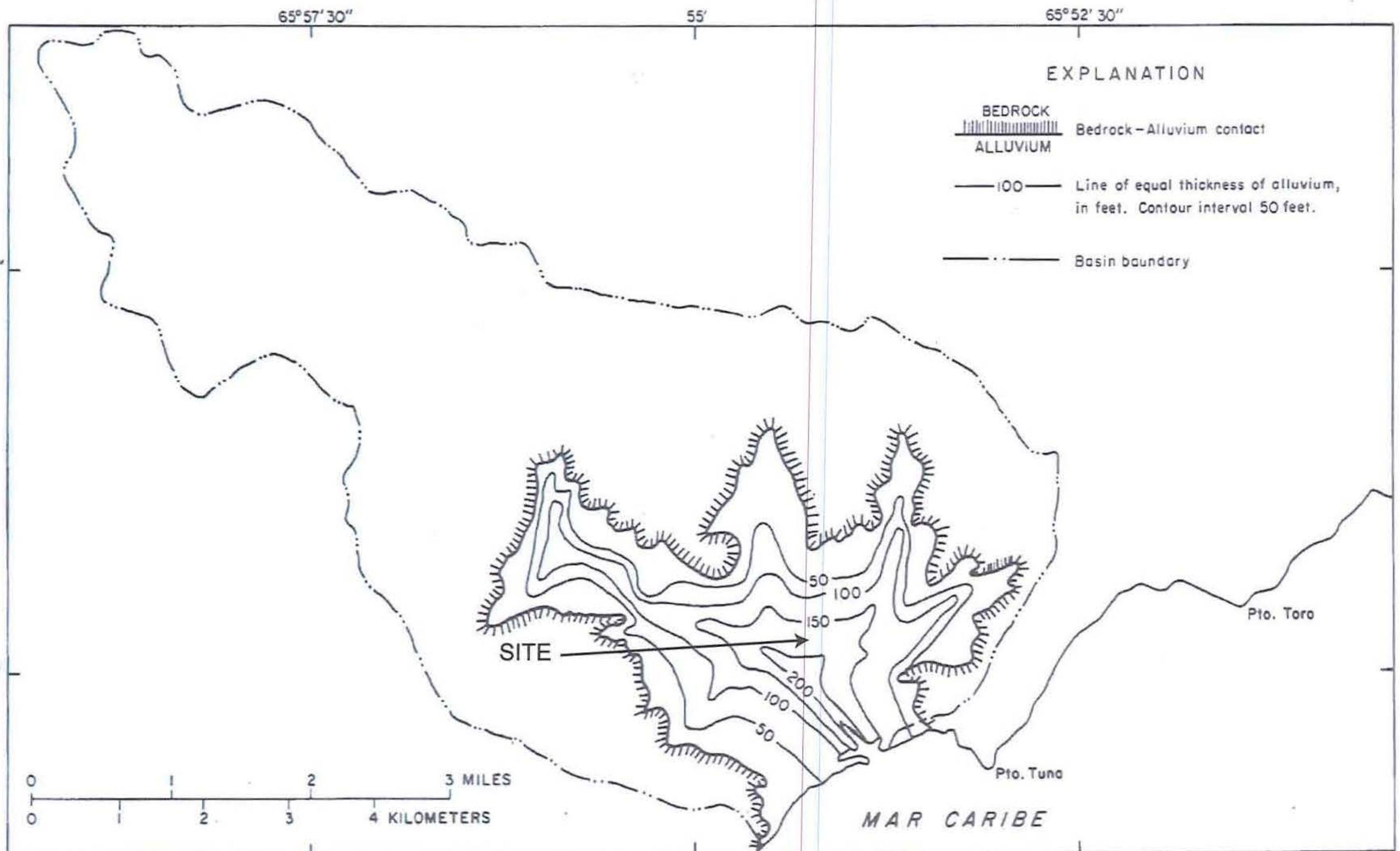


Figure 2a.--Generalized thickness of alluvium.

(Adolphson 1977)

N

CDM

Figure 3-2
Alluvium Thickness Map
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

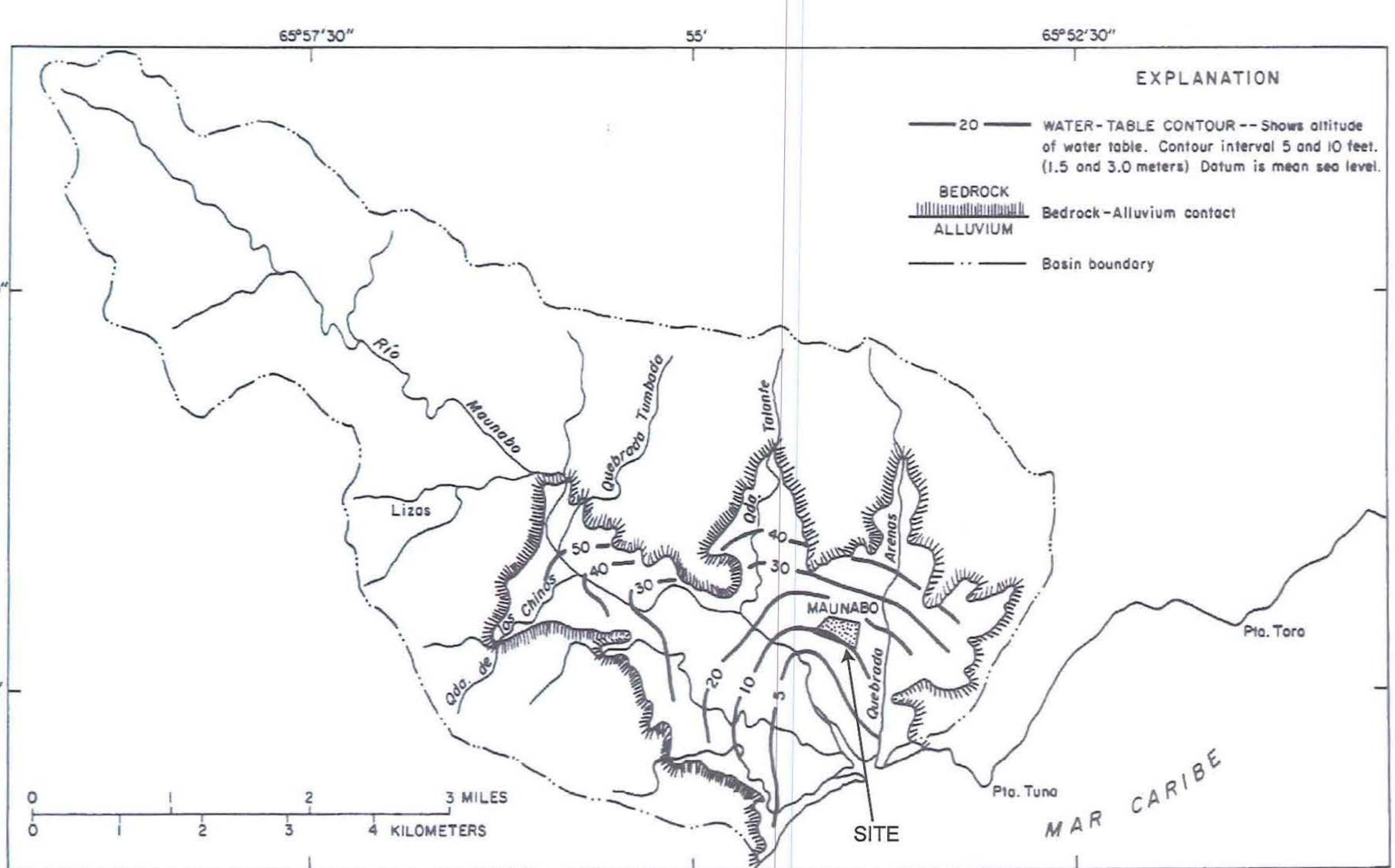


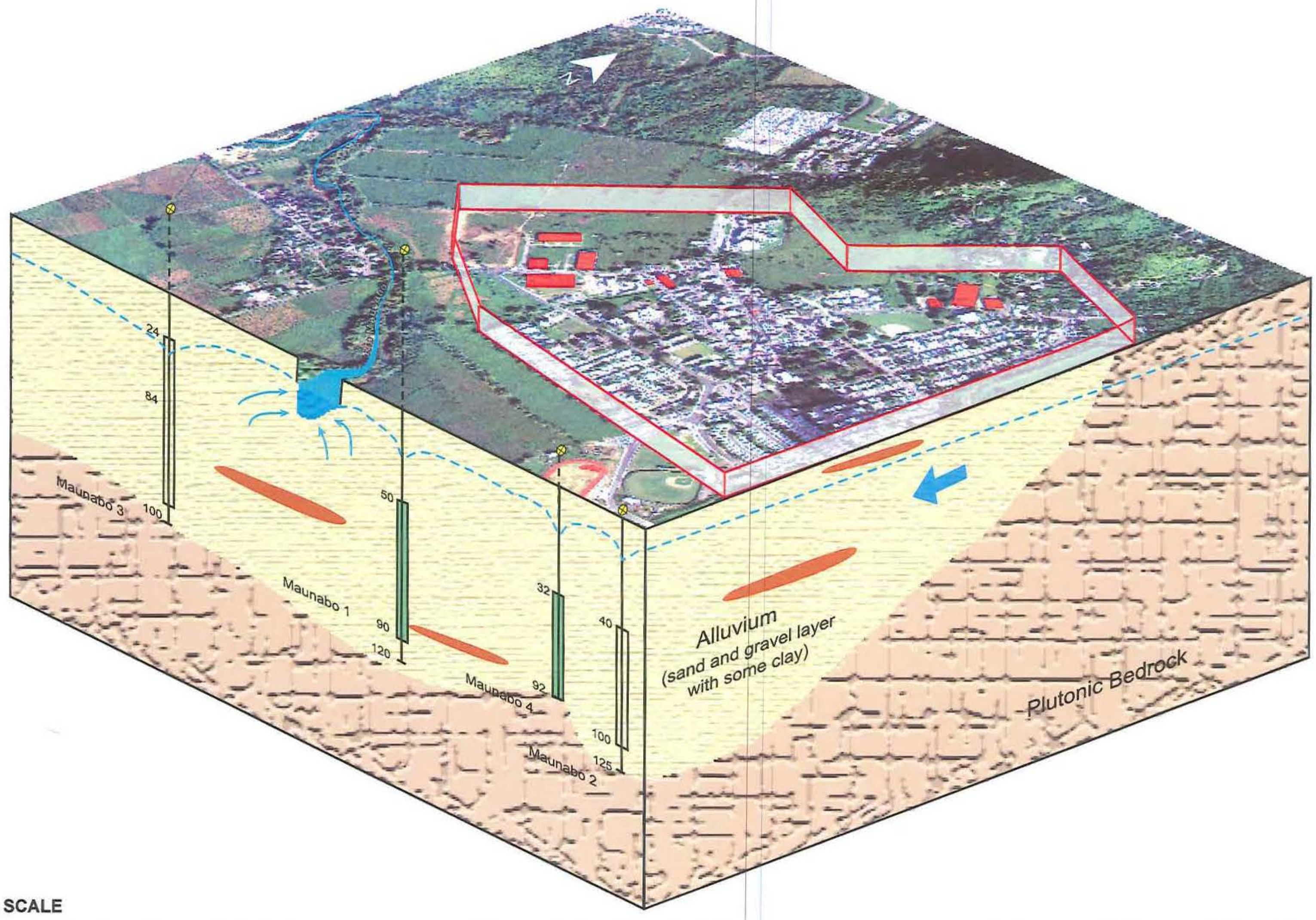
Figure 4.--Water-table contours in alluvial aquifer on June 13, 1974.

(Adolphson 1977)

CDM

N

Figure 3-4
Direction of Groundwater Flow
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico



Supply Well Location	Clay Layers	Groundwater Table
Screen Interval and Depths in Feet	Potential Source Area	Potential Sources
Supply Well with VOC detections	Assumed Groundwater Flow Direction	

CDM

Figure 3-5
Conceptual Site Model
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

C:\IMS\GIS\Maunabo\GIS_projects\site_map.mxd

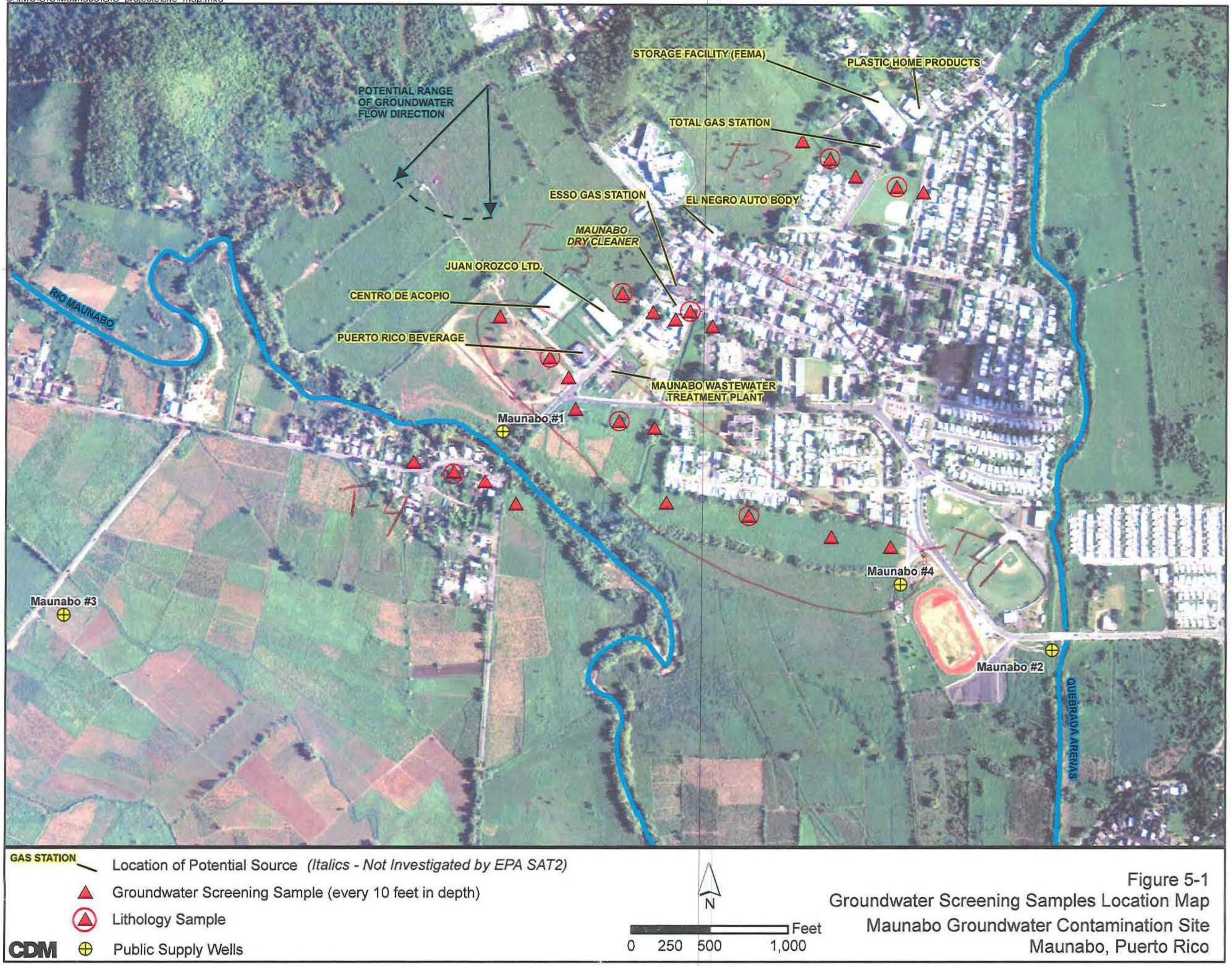


Figure 5-1
Groundwater Screening Samples Location Map
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

R2-0000139

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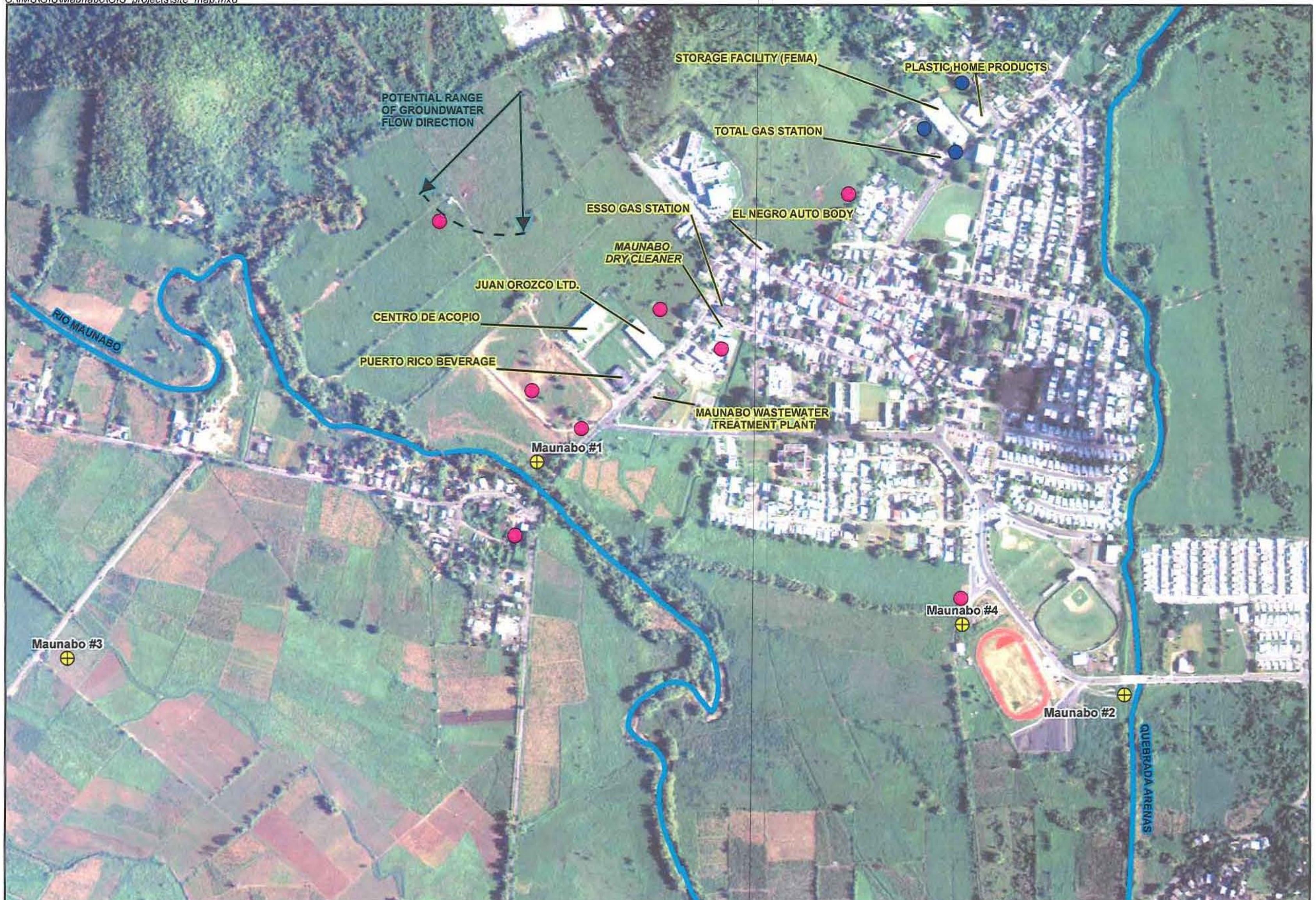

GAS STATION Location of Potential Source *(Italics - Not Investigated by EPA SAT2)*

Bedrock Monitoring Well (Storage Facility)

Monitoring Well (Shallow and Deep Cluster)

Public Supply Wells

CDM

Move well across river downfrom old factory

N

0 250 500 1,000 Feet

Figure 5-2
Monitoring Well Location Map
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

R2-0000140

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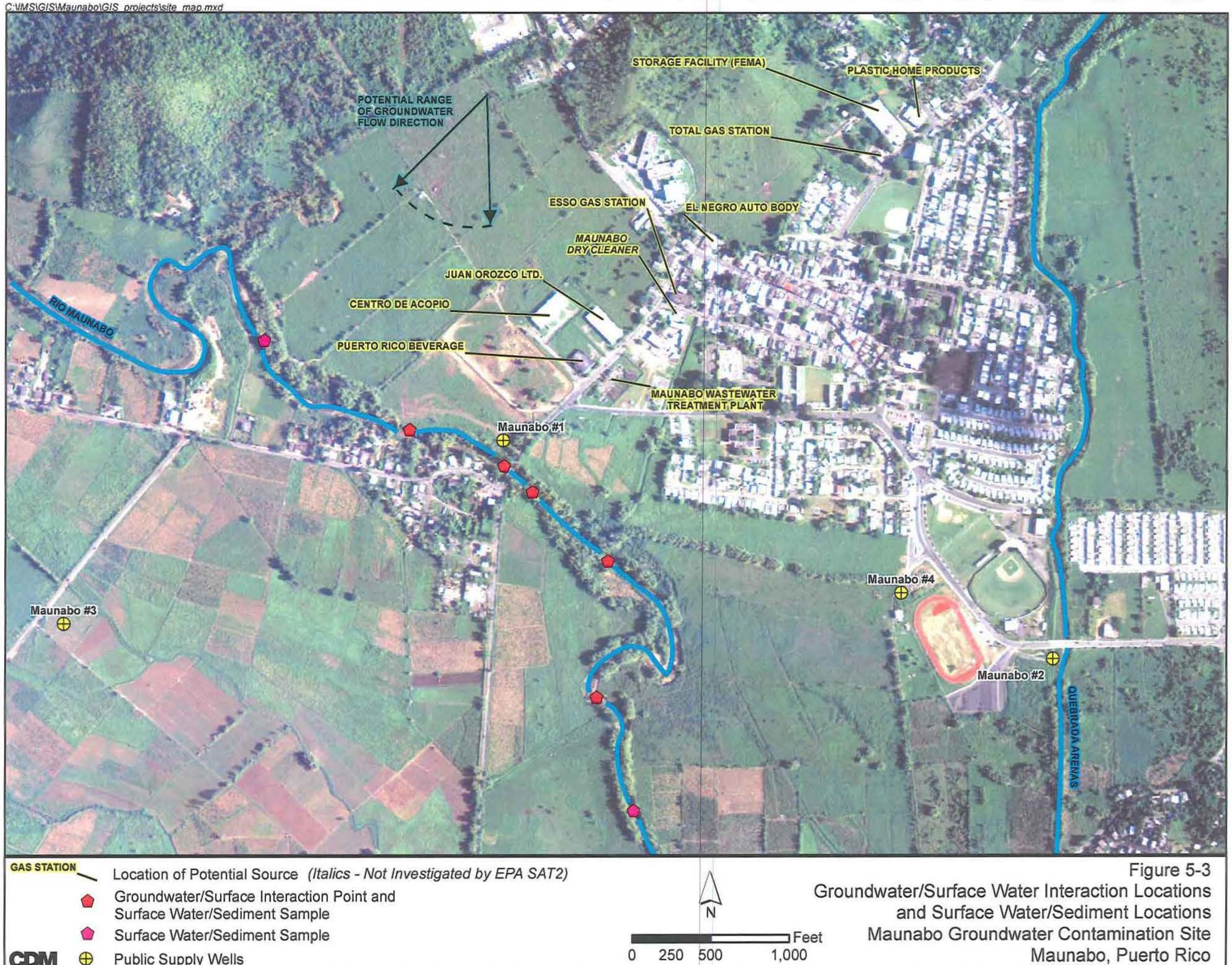
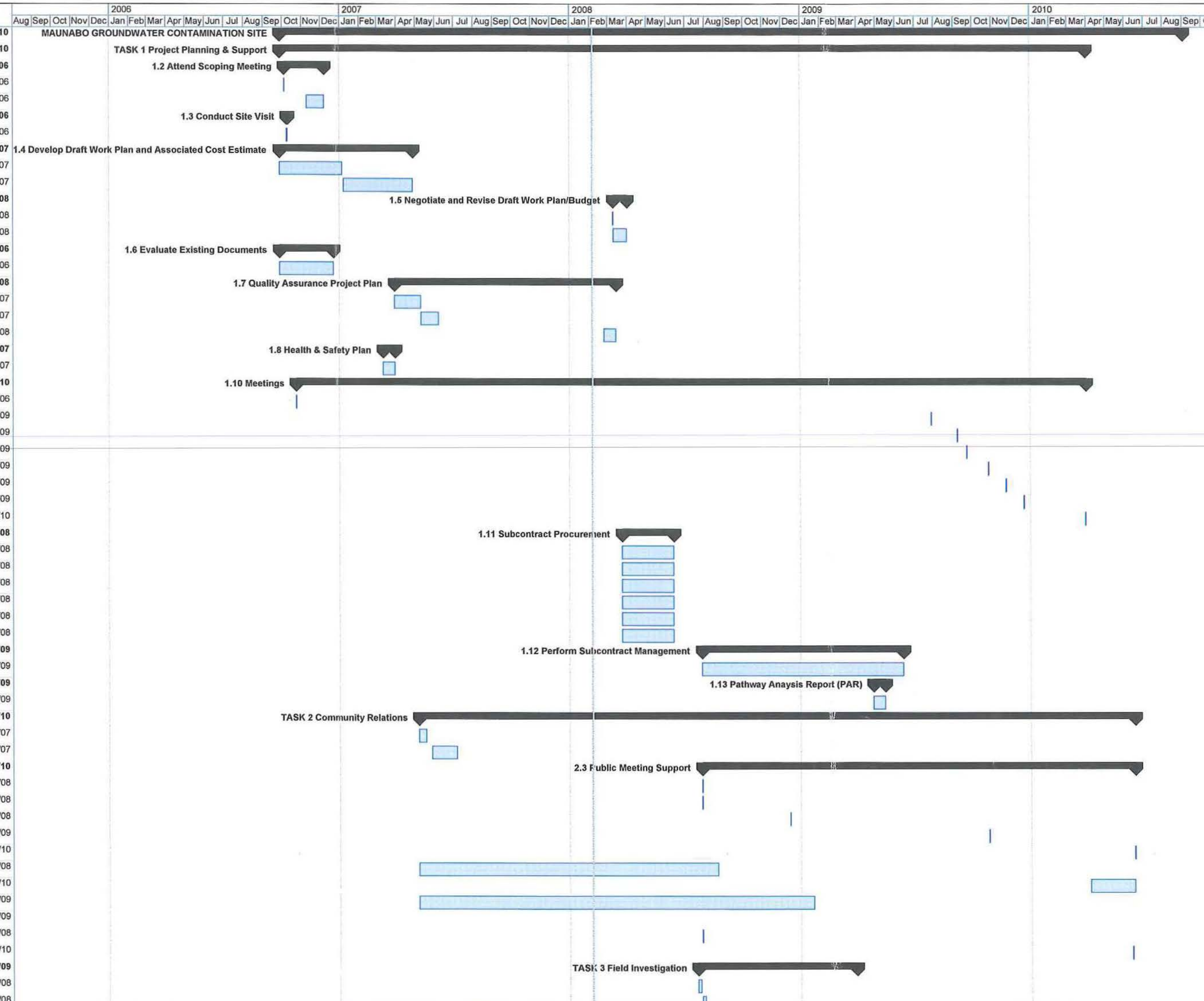


Figure 5-3
Groundwater/Surface Water Interaction Locations
and Surface Water/Sediment Locations
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico

R2-0000141

Figure 6-1
Maunabo Groundwater Contamination Site
Project Schedule

ID	Task Name	Duration	Start	Finish
1	**MAUNABO GROUNDWATER CONTAMINATION SITE**	**1025 days**	**9/28/06**	**9/1/10**
2	**TASK 1 Project Planning & Support**	**914 days**	**9/28/06**	**3/30/10**
3	**1.2 Attend Scoping Meeting**	**46 days**	**10/5/06**	**12/7/06**
4	Contractural Scoping Meeting	1 day	10/5/06	10/5/06
5	Preparation and Attendance at Technical Scoping Meeting	20 days	11/10/06	12/7/06
6	**1.3 Conduct Site Visit**	**2 days**	**10/9/06**	**10/10/06**
7	1.3 Conduct Site Visit	2 days	10/9/06	10/10/06
8	**1.4 Develop Draft Work Plan and Associated Cost Estimate**	**152 days**	**9/28/06**	**4/27/07**
9	Develop Draft Work Plan and Associated Cost Estimate	72 days	9/28/06	1/5/07
10	EPA Review of Draft Work Plan	80 days	1/8/07	4/27/07
11	**1.5 Negotiate and Revise Draft Work Plan/Budget**	**16 days**	**3/10/08**	**3/31/08**
12	Negotiate Budget	1 day	3/10/08	3/10/08
13	Prepare/Submit Final Work Plan	15 days	3/11/08	3/31/08
14	**1.6 Evaluate Existing Documents**	**62 days**	**9/28/06**	**12/22/06**
15	1.6 Evaluate Existing Documents	62 days	9/28/06	12/22/06
16	**1.7 Quality Assurance Project Plan**	**251 days**	**3/30/07**	**3/14/08**
17	Prepare/Submit Draft QAPP	30 days	3/30/07	5/10/07
18	EPA Review	20 days	5/11/07	6/7/07
19	Prepare/Submit Final QAPP	15 days	2/25/08	3/14/08
20	**1.8 Health & Safety Plan**	**15 days**	**3/12/07**	**3/30/07**
21	1.8 Health & Safety Plan	15 days	3/12/07	3/30/07
22	**1.10 Meetings**	**896 days**	**10/24/06**	**3/30/10**
23	First Meeting - Access Meeting with Municpality	1 day	10/24/06	10/24/06
24	Second Meeting - Decision Meeting for Final Monitoring Well Locations	1 day	7/28/09	7/28/09
25	Third Meeting - RA	1 day	9/7/09	9/7/09
26	Fourth Meeting - SLERA	1 day	9/22/09	9/22/09
27	Fifth Meeting - Draft RI	1 day	10/27/09	10/27/09
28	Sixth Meeting - FS Tech memo 1	1 day	11/24/09	11/24/09
29	Seventh Meeting - FS Tech Memo 2	1 day	12/22/09	12/22/09
30	Eighth Meeting - Draft FS	1 day	3/30/10	3/30/10
31	**1.11 Subcontract Procurement**	**60 days**	**3/24/08**	**6/13/08**
32	Topographic Survey	60 days	3/24/08	6/13/08
33	Geophysical Services (downhole logging)	60 days	3/24/08	6/13/08
34	Drilling Services	60 days	3/24/08	6/13/08
35	Analytical Laboratory	60 days	3/24/08	6/13/08
36	Waste Hauling and Disposal	60 days	3/24/08	6/13/08
37	Cultural Resources	60 days	3/24/08	6/13/08
38	**1.12 Perform Subcontract Management**	**230 days**	**7/28/08**	**6/12/09**
39	Perform Subcontract Management	230 days	7/28/08	6/12/09
40	**1.13 Pathway Anaysis Report (PAR)**	**15 days**	**4/27/09**	**5/15/09**
41	1.13 Pathway Anaysis Report (PAR)	15 days	4/27/09	5/15/09
42	**TASK 2 Community Relations**	**812 days**	**5/7/07**	**6/15/10**
43	2.1 Community Interviews	10 days	5/7/07	5/18/07
44	2.2 Community Relations Plan	30 days	5/28/07	7/6/07
45	**2.3 Public Meeting Support**	**492 days**	**7/28/08**	**6/15/10**
46	Public Meetings 1 - beginning of field work	1 day	7/28/08	7/28/08
47	Public Availability Session 1	1 day	7/28/08	7/28/08
48	Public Availability Session 2	1 day	12/15/08	12/15/08
49	Public Meetings 2 - Final RI	1 day	10/27/09	10/27/09
50	Public Meetings 3 - Final proposed plan	1 day	6/15/10	6/15/10
51	2.4 Fact Sheet Preparation	339 days	5/7/07	8/21/08
52	2.5 Proposed Plan Support	50 days	4/6/10	6/14/10
53	2.6 Public Notices	448 days	5/7/07	1/21/09
54	2.7 Information Repositories (Not Appicable)	1 day	1/21/09	1/21/09
55	2.8 Site Mailing List	1 day	7/28/08	7/28/08
56	2.9 Responsiveness Summary Support	1 day	6/11/10	6/11/10
57	**TASK 3 Field Investigation**	**181 days**	**7/21/08**	**3/30/09**
58	Mobilization	5 days	7/21/08	7/25/08
59	Site Reconnaissance - Locate Wells/Soil Borings/Screening Points	5 days	7/28/08	8/1/08



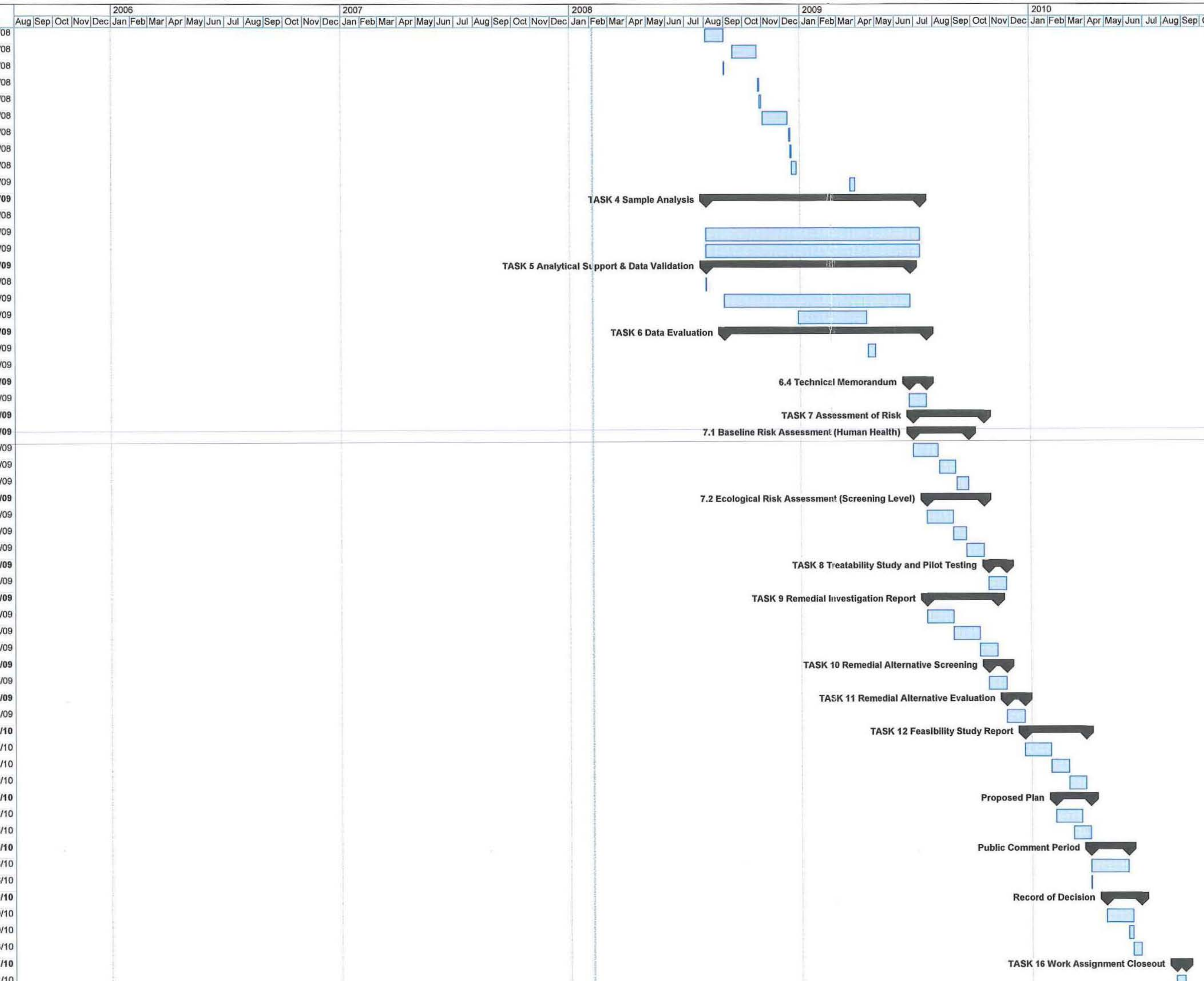
Project: 171 fig_6_1_Schedule
Date: 2/5/08

Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary | Group By Summary

R2-0000142

Figure 6-1
Maunabo Groundwater Contamination Site
Project Schedule

ID	Task Name	Duration	Start	Finish
60	Groundwater Screening	21 days	8/4/08	9/1/08
61	Monitoring Well Installation and Development	29 days	9/16/08	10/24/08
62	Source Area Investigation - Soil Sampling	1 day	9/2/08	9/2/08
63	Gamma Logging	2 days	10/27/08	10/28/08
64	Aquifer Testing	3 days	10/29/08	10/31/08
65	Long-term Groundwater Level Monitoring	30 days	11/3/08	12/12/08
66	Groundwater/Surface Water Interaction Evaluation	2 days	12/15/08	12/16/08
67	Surface Water and Sediment Sampling	2 days	12/17/08	12/18/08
68	Monitoring Well Sampling - Round 1	6 days	12/19/08	12/26/08
69	Monitoring Well Sampling - Round 2	6 days	3/23/09	3/30/09
70	**TASK 4 Sample Analysis**	**245 days**	**8/4/08**	**7/10/09**
71	4.1 Innovative Methods/Field Screening Sample Analysis (Not Applicable)	1 day	8/4/08	8/4/08
72	4.2 Analytical Services Provided Via CLP or DESA	245 days	8/4/08	7/10/09
73	4.3 Non-Routine Analytical Services (Subcontracted Analytical Services)	245 days	8/4/08	7/10/09
74	**TASK 5 Analytical Support & Data Validation**	**233 days**	**8/4/08**	**6/24/09**
75	5.1 Collect, Prepare and Ship Samples (Under Task 3)	1 day	8/4/08	8/4/08
76	5.2 Sample Management	212 days	9/2/08	6/24/09
77	5.3 Data Validation	80 days	12/29/08	4/17/09
78	**TASK 6 Data Evaluation**	**230 days**	**9/2/08**	**7/20/09**
79	6.1 Data Usability Evaluation	10 days	4/20/09	5/1/09
80	6.2 Data Reduction, Tabulation, and Evaluation	210 days	9/2/08	6/22/09
81	**6.4 Technical Memorandum**	**20 days**	**6/23/09**	**7/20/09**
82	Data Evaluation Summary Report	20 days	6/23/09	7/20/09
83	**TASK 7 Assessment of Risk**	**81 days**	**6/29/09**	**10/19/09**
84	**7.1 Baseline Risk Assessment (Human Health)**	**65 days**	**6/29/09**	**9/25/09**
85	Prepare Draft Risk Assessment (HH)	30 days	6/29/09	8/7/09
86	EPA Review of Draft Risk Assessment (HH)	20 days	8/10/09	9/4/09
87	Prepare Final Risk Assessment (HH)	15 days	9/7/09	9/25/09
88	**7.2 Ecological Risk Assessment (Screening Level)**	**65 days**	**7/21/09**	**10/19/09**
89	Prepare Draft Ecological Risk Assessment	30 days	7/21/09	8/31/09
90	EPA Review of Draft Ecological Risk Assessment	15 days	9/1/09	9/21/09
91	Prepare Final Ecological Risk Assessment	20 days	9/22/09	10/19/09
92	**TASK 8 Treatability Study and Pilot Testing**	**20 days**	**10/27/09**	**11/23/09**
93	8.1 Literature Search	20 days	10/27/09	11/23/09
94	**TASK 9 Remedial Investigation Report**	**80 days**	**7/21/09**	**11/9/09**
95	Prepare Draft RI Report	30 days	7/21/09	8/31/09
96	EPA Review of Draft RI Report	30 days	9/1/09	10/12/09
97	Prepare Final RI Report	20 days	10/13/09	11/9/09
98	**TASK 10 Remedial Alternative Screening**	**20 days**	**10/27/09**	**11/23/09**
99	Technical Memorandum	20 days	10/27/09	11/23/09
100	**TASK 11 Remedial Alternative Evaluation**	**20 days**	**11/24/09**	**12/21/09**
101	Technical Memorandum	20 days	11/24/09	12/21/09
102	**TASK 12 Feasibility Study Report**	**70 days**	**12/22/09**	**3/29/10**
103	Prepare Draft FS Report	30 days	12/22/09	2/1/10
104	EPA Review of FS Report	20 days	2/2/10	3/1/10
105	Prepare Final FS Report	20 days	3/2/10	3/29/10
106	**Proposed Plan**	**40 days**	**2/9/10**	**4/5/10**
107	Draft Proposed Plan to ERRD, ORC, PR	30 days	2/9/10	3/22/10
108	Final Proposed Plan to Public	20 days	3/9/10	4/5/10
109	**Public Comment Period**	**43 days**	**4/6/10**	**6/3/10**
110	Public Comment Period	43 days	4/6/10	6/3/10
111	Proposed Plan Public Meeting	1 day	4/6/10	4/6/10
112	**Record of Decision**	**39 days**	**4/30/10**	**6/23/10**
113	Draft ROD to ERRD, ORC, PR	30 days	4/30/10	6/10/10
114	Responsiveness Summary	5 days	6/4/10	6/10/10
115	Final ROD For Signature	9 days	6/11/10	6/23/10
116	**TASK 16 Work Assignment Closeout**	**10 days**	**8/19/10**	**9/1/10**
117	Closeout	10 days	8/19/10	9/1/10

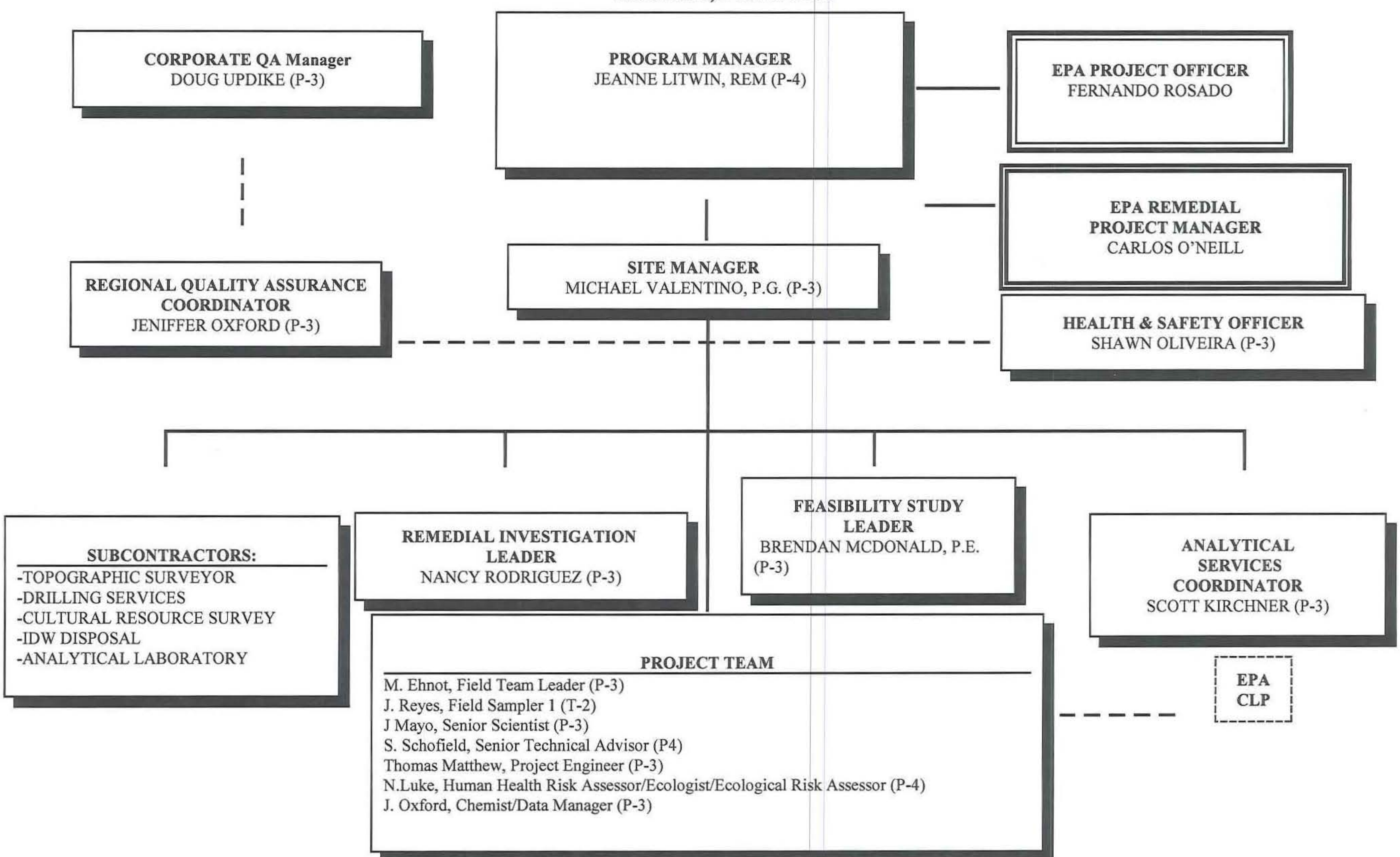


Project: 171 fig_6_1_Schedule
Date: 2/5/08

Task	Milestone	Rolled Up Task	Rolled Up Progress	External Tasks	Group By Summary
Progress	Summary	Rolled Up Milestone	Split	Project Summary	

R2-0000143

FIGURE 7-1
Project Organization
Maunabo Groundwater Contamination Site
Maunabo, Puerto Rico



Appendix A

Sampling Data Results from EPA SAT 2 Site Investigations

Maunabo Wells
December 2005 Field Blanks
Volatile Organic Compounds

Cas Rn	Chemical Name	Analytic Method	Sample Code / Sample Name / Sample Date / Unit \\	MUW-PHP-RIN01 12/6/2005		MUW-FEM-RIN02 12/7/2005		MUW-JUA-RIN04 12/8/2005		MUW-PRB-RIN03 12/9/2005	
(Group Code)	**(Group Description)**										
1-voa-w	**Volatile Organic Compounds**										
75-69-4	Trichlorofluoromethane	MC VOA(W)	ug/l	10	U	10	U	10	U	10	U
67-64-1	Acetone	MC VOA(W)	ug/l	10	U	10	U	10	U	3	J
75-15-0	Carbon Disulfide	MC VOA(W)	ug/l	10	U	10	U	10	U	10	UJ
75-09-2	Methylene Chloride	MC VOA(W)	ug/l	20		5	J	10	U	2	J
67-66-3	Chloroform	MC VOA(W)	ug/l	10	U	2	J	2	J	10	U
75-27-4	Bromodichloromethane	MC VOA(W)	ug/l	10	U	10	U	10	U	10	U

Maunabo Wells
December 2005 Field Blanks
Volatile Organic Compounds

Cas Rn	Chemical Name	Analytic Method	Sample Code / Sample Name / Sample Date / Unit \\	MUW-BKG-RIN08 Background 12/12/2005		MUW-WWT-RIN06 12/13/2005		MUW-CAM-RIN05 12/14/2005		MUW-MSW-RIN07 12/15/2005	
(Group Code)	**(Group Description)**										
1-voa-w	**Volatile Organic Compounds**										
75-69-4	Trichlorofluoromethane	MC VOA(W)	ug/l	1	J	10	UJ	0.5	J	10	U
67-64-1	Acetone	MC VOA(W)	ug/l	10	U	10	U	10	U	10	UJ
75-15-0	Carbon Disulfide	MC VOA(W)	ug/l	2	J	10	UJ	0.8	J	10	U
75-09-2	Methylene Chloride	MC VOA(W)	ug/l	2	J	10		12		10	
67-66-3	Chloroform	MC VOA(W)	ug/l	1	J	10	U	2	J	10	U
75-27-4	Bromodichloromethane	MC VOA(W)	ug/l	10	U	10	U	0.3	J	10	U

Maunabo Wells
December 2005 Groundwater
Detections Only

Cas Rn	Chemical Name	Analytic Method	Sample Code Sample Name Sample Date Unit \\ Depth	MUW-GS1-MW01 12/8/2005 5 to 10 ft bgs		MUW-GS1-MW02 12/8/2005 6 to 11 ft bgs		MUW-JUA-GW01 12/8/2005 8 to 12 ft bgs		MUW-PRB-GW01 12/9/2005 12 to 16 ft bgs	
(Group Code)	**(Group Description)**										
1-voa-w	**Volatile Organic Compounds**										
67-64-1	Acetone	MC VOA(W)	ug/l	44		25		-----	U	-----	U
79-20-9	Methyl Acetate	MC VOA(W)	ug/l	8	J	-----	R	-----	UJ	-----	UJ
1634-04-4	Methyl tert-Butyl Ether	MC VOA(W)	ug/l	14		7	J	-----	U	-----	U
71-43-2	Benzene	MC VOA(W)	ug/l	20		4	J	-----	U	-----	U
108-87-2	Metylcyclohexane	MC VOA(W)	ug/l	5	J	-----	U	-----	U	-----	U
100-41-4	Ethylbenzene	MC VOA(W)	ug/l	100		9	J	-----	U	-----	U
98-82-8	Isopropylbenzene	MC VOA(W)	ug/l	290		52		-----	U	-----	U

Cas Rn	Chemical Name	Analytic Method	Sample Code Sample Name Sample Date Unit \\ Depth	MUW-BKG-GW01 Background 12/12/2005 8 to 12 ft bgs		MUW-GS2-MW03 12/12/2005 5 to 10 ft bgs		MUW-GS2-MW04 12/12/2005 6 to 11 ft bgs		MUW-WWT-GW01 12/13/2005 12 to 16 ft bgs	
(Group Code)	**(Group Description)**										
1-voa-w	**Volatile Organic Compounds**										
67-64-1	Acetone	MC VOA(W)	ug/l	-----	U	-----	U	-----	U	-----	U
79-20-9	Methyl Acetate	MC VOA(W)	ug/l	-----	U	-----	U	-----	U	-----	U
1634-04-4	Methyl tert-Butyl Ether	MC VOA(W)	ug/l	-----	U	-----	U	-----	U	-----	U
71-43-2	Benzene	MC VOA(W)	ug/l	-----	U	-----	U	-----	U	-----	U
108-87-2	Metylcyclohexane	MC VOA(W)	ug/l	-----	U	-----	U	-----	U	-----	U
100-41-4	Ethylbenzene	MC VOA(W)	ug/l	-----	U	-----	U	-----	U	-----	U
98-82-8	Isopropylbenzene	MC VOA(W)	ug/l	-----	U	-----	U	-----	U	-----	UJ

Maunabo Wells
December 2005 Groundwater
Detections Only

Cas Rn	Chemical Name	Analytic Method	Sample Code Sample Name Sample Date Unit \\ Depth	MUW-CAM-GW01 12/14/2005 16 to 20 ft bgs		MUW-MSW-GW01 12/15/2005 40 to 45 ft bgs	
(Group Code)	**(Group Description)**						
1-voa-w	**Volatile Organic Compounds**						
67-64-1	Acetone	MC VOA(W)	ug/l	-----	U	-----	UJ
79-20-9	Methyl Acetate	MC VOA(W)	ug/l	-----	U	-----	UJ
1634-04-4	Methyl tert-Butyl Ether	MC VOA(W)	ug/l	-----	U	-----	U
71-43-2	Benzene	MC VOA(W)	ug/l	-----	U	-----	U
108-87-2	Metylcyclohexane	MC VOA(W)	ug/l	-----	U	-----	U
100-41-4	Ethylbenzene	MC VOA(W)	ug/l	-----	U	-----	U
98-82-8	Isopropylbenzene	MC VOA(W)	ug/l	-----	UJ	-----	U

Maunabo Wells
December 2005 Surface and Subsurface Soils
Detections Only

			Sample Code	MUW-PHP-S01		MUW-PHP-S02		MUW-PHP-S03		MUW-PHP-S04		MUW-PHP-SS01A	
			Sample Name										
			Sample Date	12/6/2005		12/6/2005		12/6/2005		12/6/2005		12/6/2005	
Cas Rn	Chemical Name	Analytic Method	Unit \\ Depth	1.5 to 1.75 ft		1.5 to 1.75 ft		1.5 to 1.75 ft		1.5 to 1.75 ft		16.5 to 16.75 ft	
(Group Code)	**(Group Description)**												
1-voa-s	**Volatile Organic Compounds**												
75-71-8	Dichlorodifluoromethane	MC VOA(LS)	ug/kg	-----	R	-----	R	-----	R	-----	R	-----	UJ
75-69-4	Trichlorofluoromethane	MC VOA(LS)	ug/kg	-----	U	-----	U	-----	U	-----	UJ	-----	U
67-64-1	Acetone	MC VOA(LS)	ug/kg	-----	UJ	9	J	-----	UJ	-----	UJ	-----	U

Maunabo Wells
December 2005 Surface and Subsurface Soils
Detections Only

			Sample Code	MUW-PHP-SS03A		MUW-FEM-S01		MUW-FEM-S02		MUW-FEM-S03		MUW-FEM-S04	
			Sample Name										
			Sample Date	12/6/2005		12/7/2005		12/7/2005		12/7/2005		12/7/2005	
Cas Rn	Chemical Name	Analytic Method	Unit \\ Depth	21.5 to 21.75 ft		1.5 to 1.75 ft		1.5 to 1.75 ft		1.5 to 1.75 ft		1.5 to 1.75 ft	
(Group Code)	**(Group Description)**												
1-voa-s	**Volatile Organic Compounds**												
75-71-8	Dichlorodifluoromethane	MC VOA(LS)	ug/kg	-----	R	-----	UJ	-----	UJ	-----	UJ	-----	UJ
75-69-4	Trichlorofluoromethane	MC VOA(LS)	ug/kg	-----	UJ	-----	U	-----	U	2	J	2	J
67-64-1	Acetone	MC VOA(LS)	ug/kg	-----	UJ	-----	U	-----	U	-----	U	-----	U

Maunabo Wells
December 2005 Surface and Subsurface Soils
Detections Only

Cas Rn	Chemical Name	Analytic Method	Sample Code / Sample Name / Sample Date / Unit \\ Depth	MUW-FEM-S04 -DUP / MUW-FEM-S05 / 12/7/2005 / 1.5 to 1.75 ft		MUW-FEM-SS01A / 12/7/2005 / 16.5 to 16.75 ft		MUW-FEM-SS03A / 12/7/2005 / 6.5 to 6.75 ft		MUW-JUA-S01 / 12/8/2005 / 1.5 to 1.75 ft	
(Group Code)	**(Group Description)**										
1-voa-s	**Volatile Organic Compounds**										
75-71-8	Dichlorodifluoromethane	MC VOA(LS)	ug/kg	-----	UJ	2	J	-----	UJ	-----	UJ
75-69-4	Trichlorofluoromethane	MC VOA(LS)	ug/kg	-----	U	4	J	-----	U	-----	U
67-64-1	Acetone	MC VOA(LS)	ug/kg	-----	U	8	J	-----	U	-----	U

Cas Rn	Chemical Name	Analytic Method	Sample Code / Sample Name / Sample Date / Unit \\ Depth	MUW-JUA-S02 12/8/2005 1.5 to 1.75 ft		MUW-JUA-S03 12/8/2005 1.5 to 1.75 ft		MUW-JUA-S04 12/8/2005 1.5 to 1.75 ft		MUW-JUA-SS01A 12/8/2005 5 to 5.25 ft		MUW-JUA-SS03A 12/8/2005 5.25 to 5.58 ft	
(Group Code)	**(Group Description)**												
1-voa-s	**Volatile Organic Compounds**												
75-71-8	Dichlorodifluoromethane	MC VOA(LS)	ug/kg	-----	UJ	-----	UJ	-----	UJ	-----	UJ	-----	UJ
75-69-4	Trichlorofluoromethane	MC VOA(LS)	ug/kg	-----	U	-----	U	-----	U	-----	U	-----	U
67-64-1	Acetone	MC VOA(LS)	ug/kg	-----	U	-----	U	-----	U	-----	U	-----	U

Cas Rn	Chemical Name	Analytic Method	Sample Code / Sample Name / Sample Date / Unit \\ Depth	MUW-JUA-SS03A-DUP / MUW-JUA-SS03B / 12/8/2005 / 5.25 to 5.58 ft		MUW-PRB-S01 / 12/9/2005 / 1.5 to 1.75 ft		MUW-PRB-S02 / 12/9/2005 / 1.5 to 1.75 ft		MUW-PRB-S03 / 12/9/2005 / 1.5 to 1.75 ft		MUW-PRB-S04 / 12/9/2005 / 1.5 to 1.75 ft	
(Group Code)	**(Group Description)**												
1-voa-s	**Volatile Organic Compounds**												
75-71-8	Dichlorodifluoromethane	MC VOA(LS)	ug/kg	-----	UJ	-----	UJ	-----	UJ	-----	UJ	-----	UJ
75-69-4	Trichlorofluoromethane	MC VOA(LS)	ug/kg	-----	U	-----	U	-----	U	-----	U	-----	U
67-64-1	Acetone	MC VOA(LS)	ug/kg	-----	U	-----	UJ	-----	UJ	-----	UJ	-----	UJ

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Cas Rn	Chemical Name	Analytic Method	Sample Code / Sample Name / Sample Date / Unit \\ Depth	MUW-PRB-SS01A 12/9/2005 5 to 5.25 ft		MUW-PRB-SS03A 12/9/2005 5 to 5.25 ft		MUW-BKG-S01 Background 12/12/2005 1.5 to 1.75 ft		MUW-BKG-S02 Background 12/12/2005 1.5 to 1.75 ft		MUW-BKG-S03 Background 12/12/2005 1.5 to 1.75 ft	
(Group Code)	(Group Description)												
1-voa-s	**Volatile Organic Compounds**												
75-71-8	Dichlorodifluoromethane	MC VOA(LS)	ug/kg	-----	UJ	-----	UJ	-----	UJ	-----	UJ	-----	UJ
75-69-4	Trichlorofluoromethane	MC VOA(LS)	ug/kg	-----	U	-----	U	-----	UJ	-----	UJ	-----	UJ
67-64-1	Acetone	MC VOA(LS)	ug/kg	-----	UJ	-----	UJ	-----	U	17	J	14	J

Cas Rn	Chemical Name	Analytic Method	Sample Code / Sample Name / Sample Date / Unit \\ Depth	MUW-BKG-S04 Background 12/12/2005 1.5 to 1.75 ft		MUW-BKG-SS01A Background 12/12/2005 4.33 to 4.67 ft		MUW-BKG-SS03A Background 12/12/2005 4.42 to 4.67 ft		MUW-AUB-01 12/13/2005 0 to 3 in		MUW-WWT-S01 12/13/2005 1.5 to 1.75 ft	
(Group Code)	(Group Description)												
1-voa-s	**Volatile Organic Compounds**												
75-71-8	Dichlorodifluoromethane	MC VOA(LS)	ug/kg	-----	UJ	-----	UJ	-----	UJ	-----	UJ	-----	UJ
75-69-4	Trichlorofluoromethane	MC VOA(LS)	ug/kg	-----	UJ	-----	UJ	-----	UJ	-----	UJ	-----	UJ
67-64-1	Acetone	MC VOA(LS)	ug/kg	-----	U	22	J	-----	U	-----	UJ	-----	UJ

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Cas Rn	Chemical Name	Analytic Method	Sample Code / Sample Name / Sample Date / Unit \\ Depth	MUW-WWT-S02 12/13/2005 1.5 to 1.75 ft		MUW-WWT-S03 12/13/2005 1.5 to 1.75 ft		MUW-WWT-S04 12/13/2005 1.67 to 1.92 ft		MUW-WWT-SS01A 12/13/2005 6 to 6.25 ft	
(Group Code)	(Group Description)										
1-voa-s	**Volatile Organic Compounds**										
75-71-8	Dichlorodifluoromethane	MC VOA(LS)	ug/kg	-----	UJ	-----	UJ	-----	UJ	-----	UJ
75-69-4	Trichlorofluoromethane	MC VOA(LS)	ug/kg	-----	UJ	-----	UJ	-----	UJ	-----	UJ
67-64-1	Acetone	MC VOA(LS)	ug/kg	-----	UJ	-----	UJ	-----	UJ	3	J

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Cas Rn	Chemical Name	Analytic Method	Sample Code Sample Name Sample Date Unit \\ Depth	MUW-GW01 10/25/2005 to		MUW-GW02 10/25/2005 to		MUW-GW03 10/25/2005 to		MUW-GW04 10/25/2005 to	
4-p/pcbs-w	**Pesticides/PCBs**										
319-86-8	delta-BHC	MC PEST(W)	ug/l	-----	U	-----	U	-----	U	-----	U
58-89-9	gamma-BHC (Lindane)	MC PEST(W)	ug/l	-----	U	-----	U	-----	U	-----	U
60-57-1	Dieldrin	MC PEST(W)	ug/l	-----	U	-----	U	0.002	J	-----	U
50-29-3	4,4'-DDT	MC PEST(W)	ug/l	-----	U	-----	U	-----	U	-----	U
7421-93-4	Endrin aldehyde	MC PEST(W)	ug/l	-----	U	-----	U	-----	U	0.001	J
5103-74-2	gamma-Chlordane	MC PEST(W)	ug/l	-----	U	-----	U	-----	U	-----	U

CAS No.	COMPOUND NAME	UNITS	EPA Primary Drinking Water MCLs ***
75-71-8	DICHLORODIFLUOROMETHANE	ug/l	NA
74-87-3	CHLOROMETHANE	ug/l	NA
75-01-4	VINYL CHLORIDE	ug/l	2
74-83-9	BROMOMETHANE	ug/l	NA
75-00-3	CHLOROETHANE	ug/l	NA
1634-04-4	METHYL-TERT-BUTYL-ETHER	ug/l	NA
75-15-0	CARBON DISULFIDE	ug/l	NA
78-93-3	2-BUTANONE	ug/l	NA
67-64-1	ACETONE	ug/l	NA
75-69-4	TRICHLOROFLUOROMETHANE	ug/l	NA
75-35-4	1,1-DICHLOROETHENE	ug/l	7
76-13-1	1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	ug/l	NA
75-09-2	METHYLENE CHLORIDE	ug/l	5
156-60-5	1,2-TRANS-DICHLOROETHYLENE	ug/l	100
75-34-3	1,1-DICHLOROETHANE	ug/l	NA
67-66-3	CHLOROFORM	ug/l	NA
74-97-5	BROMOCHLOROMETHANE	ug/l	NA
71-55-6	1,1,1-TRICHLOROETHANE	ug/l	200
110-82-7	CYCLOHEXANE	ug/l	NA
56-23-5	CARBON TETRACHLORIDE	ug/l	5
107-06-2	1,2-DICHLOROETHANE	ug/l	5
71-43-2	BENZENE	ug/l	5
79-01-6	TRICHLOROETHYLENE	ug/l	5
78-87-5	1,2-DICHLOROPROPANE	ug/l	5
108-10-1	4-METHYL-2-PENTANONE	ug/l	NA
127-18-4	TETRACHLOROETHYLENE	ug/l	5
156-59-2	1,2-cis-DICHLOROETHENE	ug/l	70
75-27-4	BROMODICHLOROMETHANE	ug/l	NA
10061-02-6	Trans 1,3-DICHLOROPROPENE	ug/l	NA
108-88-3	TOLUENE	ug/l	1000
10061-01-5	cis 1,3-DICHLOROPROPENE	ug/l	NA
591-78-6	2-HEXANONE	ug/l	NA
79-00-5	1,1,2-TRICHLOROETHANE	ug/l	5
124-48-1	DIBROMOCHLOROMETHANE	ug/l	NA
106-93-4	1,2-DIBROMOETHANE	ug/l	0.05
108-90-7	CHLOROBENZENE	ug/l	100
100-41-4	ETHYLBENZNE	ug/l	700
1330-20-7	m+p-XYLENES	ug/l	10000
95-47-6	o-XYLENE	ug/l	10000
100-42-5	STYRENE	ug/l	100
98-82-8	ISOPROPYL BENZENE	ug/l	NA
75-25-2	BROMOFORM	ug/l	NA
79-34-5	1,1,2,2-TETRACHLOROETHANE	ug/l	NA
96-12-8	1,2-DIBROMO-3-CHLOROPROPANE	ug/l	0.2
100-52-7	BENZALDEHYDE	ug/l	NA
108-95-2	PHENOL	ug/l	NA
111-44-4	BIS (2-CHLOROETHYL) ETHER	ug/l	NA
95-57-8	2-CHLOROPHENOL	ug/l	NA
541-73-1	1,3-DICHLOROBENZENE	ug/l	600
106-46-7	1,4-DICHLOROBENZENE	ug/l	75
95-50-1	1,2-DICHLOROBENZENE	ug/l	NA
95-48-7	2-METHYLPHENOL	ug/l	NA

CAS No.	COMPOUND NAME	UNITS	EPA Primary Drinking Water MCLs ***
108-60-1	2,2'-oxybis (1-Chloropropane)	ug/l	NA
98-86-2	ACETOPHENONE	ug/l	NA
106-44-5	4 METHYLPHENOL	ug/l	NA
621-64-7	N-NITROSO-DI-N-PROPYLAMINE	ug/l	NA
67-72-1	HEXACHLOROETHANE	ug/l	NA
98-95-3	NITROBENZENE	ug/l	NA
78-59-1	ISOPHORONE	ug/l	NA
88-75-5	2-NITROPHENOL	ug/l	NA
105-67-9	2,4-DIMETHYLPHENOL	ug/l	NA
111-91-1	BIS (2-CHLOROETHOXY) METHANE	ug/l	NA
120-83-2	2,4-DICHLOROPHENOL	ug/l	NA
120-82-1	1,2,4-TRICHLOROBENZENE	ug/l	70
91-20-3	NAPHTHALENE	ug/l	NA
106-47-8	4-CHLOROANILINE	ug/l	NA
87-68-3	HEXACHLOROBUTADIENE	ug/l	NA
105-60-2	CAPROLACTAM	ug/l	NA
59-50-7	4-CHLORO-3-METHYLPHENOL	ug/l	NA
91-57-6	2-METHYLNAPHTHALENE	ug/l	NA
77-47-4	HEXACHLOROCYCLOPENTADIENE	ug/l	50
88-06-2	2,4,6-TRICHLOROPHENOL	ug/l	NA
95-95-4	2,4,5-TRICHLOROPHENOL	ug/l	NA
92-52-4	1,1'-BIPHENYL	ug/l	NA
91-58-7	2-CHLORONAPHTHALENE	ug/l	NA
88-74-4	2-NITROANILINE	ug/l	NA
131-11-3	DIMETHYLPHTHALALTE	ug/l	NA
208-96-8	ACENAPHTHYLENE	ug/l	NA
606-20-2	2,6-DINITROTOLUENE	ug/l	NA
99-09-2	3-NITROANILINE	ug/l	NA
83-32-9	ACENAPHTHENE	ug/l	NA
51-28-5	2,4-DINITROPHENOL	ug/l	NA
100-02-7	4-NITROPHENOL	ug/l	NA
132-64-9	DIBENZOFURAN	ug/l	NA
121-14-2	2,4-DINITROTOLUENE	ug/l	NA
84-66-2	DIETHYLPHTHALATE	ug/l	NA
7005-72-3	4-CHLOROPHENYL-PHENYLETHER	ug/l	NA
86-73-7	FLUORENE	ug/l	NA
100-01-6	4-NITROANILINE	ug/l	NA
534-52-1	4,6-DINITRO-2-METHYLPHENOL	ug/l	NA
86-30-6	N-NITROSODIPHENYLAMINE	ug/l	NA
101-55-3	4-BROMOPHENYL-PHENYLETHER	ug/l	NA
118-74-1	HEXACHLOROBENZENE	ug/l	1
1912-24-9	ATRAZINE	ug/l	NA
87-86-5	PENTALCHLOROPHENOL	ug/l	1
85-01-8	PHENANTHRENE	ug/l	NA
120-12-7	ANTHRACENE	ug/l	NA
86-74-8	CARBAZOLE	ug/l	NA
84-74-2	DI-N-BUTYLPHTHALATE	ug/l	NA
206-44-0	FLUORANTHENE	ug/l	NA
129-00-0	PYRENE	ug/l	NA
85-68-7	BUTYLBENZYLPHTHALATE	ug/l	NA
91-94-1	3,3'-DICHLOROBENZIDINE	ug/l	NA

CAS No.	COMPOUND NAME	UNITS	EPA Primary Drinking Water MCLs ***
56-55-3	BENZO (A) ANTHRACENE	ug/l	NA
218-01-9	CHRYSENE	ug/l	NA
117-81-7	BIS (2-ETHYLHEXYL) PHTHALATE	ug/l	6
117-84-0	DI-N-OCTYLPHTHALATE	ug/l	NA
205-99-2	BENZO(B)FLUORANTHENE	ug/l	NA
207-08-9	BENZO(K) FLUORANTHENE	ug/l	NA
50-32-8	BENZO (A) PYRENE	ug/l	0.2
193-39-5	INDENO (1,2,3-CD) PYRENE	ug/l	NA
53-70-3	DIBENZO (A,H) ANTHRACENE	ug/l	NA
191-24-2	BENZO (G,H,I) PERYLENE	ug/l	NA
319-84-6	ALPHA-BHC	ug/l	NA
319-85-7	BETA-BHC	ug/l	NA
319-86-8	DELTA-BHC	ug/l	NA
58-89-9	LINDANE, TOTAL	ug/l	0.2
76-44-8	HEPTACHLOR	ug/l	0.4
309-00-2	ALDRIN	ug/l	NA
1024-57-3	HEPTACHLOR EPOXIDE	ug/l	0.2
959-98-8	ENDOSULFAN I	ug/l	NA
60-57-1	DIELDRIN	ug/l	NA
72-55-9	4,4'-DDE	ug/l	NA
72-20-8	ENDRIN, TOTAL	ug/l	2
33213-65-9	ENDOSULFAN II	ug/l	NA
72-54-8	4,4'-DDD	ug/l	NA
1031-07-8	ENDOSULFAN SULFATE	ug/l	NA
50-29-3	4,4'-DDT	ug/l	NA
72-43-5	METHOXYCHLOR	ug/l	40
53494-70-5	ENDRIN KETONE	ug/l	NA
7421-93-4	ENDRIN ALDEHYDE	ug/l	NA
5103-71-9	ALPHA-CHLORDANE	ug/l	2
5103-74-2	GAMMA-CHLORDANE	ug/l	2
8001-35-2	TOXAPHENE	ug/l	3
12674-11-2	AROCLOR-1016	ug/l	0.5
11104-28-2	AROCLOR-1221	ug/l	0.5
11141-16-5	AROCLOR-1232	ug/l	0.5
53469-21-9	AROCLOR-1242	ug/l	0.5
12672-29-6	AROCLOR-1248	ug/l	0.5
11097-69-1	AROCLOR-1254	ug/l	0.5
11096-82-5	AROCLOR-1260	ug/l	0.5
7429-90-5	ALUMINUM	ug/l	NA
7440-36-0	ANTIMONY	ug/l	6
7440-38-2	ARSENIC	ug/l	50
7440-39-3	BARIUM	ug/l	2000
7440-41-7	BERYLLIUM	ug/l	4
7440-43-9	CADMIUM	ug/l	5
7440-70-2	CALCIUM	ug/l	NA
7440-47-3	CHROMIUM	ug/l	100
7440-48-4	COBALT	ug/l	NA
7440-50-8	COPPER	ug/l	1300
7439-89-6	IRON	ug/l	NA
7439-92-1	LEAD	ug/l	15
7439-95-4	MAGNESIUM	ug/l	NA

CAS No.	COMPOUND NAME	UNITS	EPA Primary Drinking Water MCLs ***
7439-96-5	MANGANESE	ug/l	NA
7439-97-6	MERCURY	ug/l	2
7440-02-0	NICKEL	ug/l	NA
7440-09-7	POTASSIUM	ug/l	NA
7782-49-2	SELENIUM	ug/l	50
7440-22-4	SILVER	ug/l	NA
7440-23-5	SODIUM	ug/l	
7440-28-0	THALLIUM	ug/l	2
7440-62-2	VANADIUM	ug/l	NA
7440-66-6	ZINC	ug/l	NA
57-12-5	CYANIDE	ug/l	200

*** From EPA Primary Drinking Water Standards (Web Page), EPA 810-F-94-001, December 1999

Cas Rn	Chemical Name	Analytic Method	Sample Code / Sample Name / Sample Date / Unit \\ Depth	MUW-WWT-SS03A 12/13/2005 6 to 6.25 ft		MUW-CAM-S01 12/14/2005 1.5 to 1.75 ft		MUW-CAM-S02 12/14/2005 1.5 to 1.75 ft		MUW-CAM-S03 12/14/2005 1.5 to 1.75 ft		MUW-CAM-S04 12/14/2005 1.5 to 1.75 ft	
(Group Code)	**(Group Description)**												
1-voa-s	**Volatile Organic Compounds**												
75-71-8	Dichlorodifluoromethane	MC VOA(LS)	ug/kg	-----	UJ	-----	UJ	-----	UJ	-----	UJ	-----	UJ
75-69-4	Trichlorofluoromethane	MC VOA(LS)	ug/kg	-----	UJ	2	J	-----	U	-----	U	-----	U
67-64-1	Acetone	MC VOA(LS)	ug/kg	-----	UJ	-----	UJ	-----	UJ	-----	UJ	-----	UJ

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Cas Rn	Chemical Name	Analytic Method	Sample Code / Sample Name / Sample Date / Unit \\ Depth	MUW-CAM-SS01A 12/14/2005 5.42 to 5.67 ft		MUW-CAM-SS03A 12/14/2005 5.42 to 5.67 ft		MUW-MSW-S01 12/15/2005 1.5 to 1.75 ft		MUW-MSW-S03 12/15/2005 0.42 to 0.67 ft	
(Group Code)	**(Group Description)**										
1-voa-s	**Volatile Organic Compounds**										
75-71-8	Dichlorodifluoromethane	MC VOA(LS)	ug/kg	-----	UJ	2	J	-----	U	-----	U
75-69-4	Trichlorofluoromethane	MC VOA(LS)	ug/kg	2	J	3	J	-----	U	-----	U
67-64-1	Acetone	MC VOA(LS)	ug/kg	-----	UJ	18	J	-----	UJ	-----	UJ

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Cas Rn	Chemical Name	Analytic Method	Sample Code / Sample Name / Sample Date / Unit \\ Depth	MUW-MSW-S04 12/15/2005 0.5 to 2.5 in		MUW-MSW-S04-DUP MUW-MSW-S05 12/15/2005 0.5 to 2.5 in		MUW-MSW-SS04 12/15/2005 9.5 to 9.75 ft	
(Group Code)	(Group Description)								
1-voa-s	Volatile Organic Compounds								
75-71-8	Dichlorodifluoromethane	MC VOA(LS)	ug/kg	-----	U	-----	U	-----	U
75-69-4	Trichlorofluoromethane	MC VOA(LS)	ug/kg	-----	U	-----	U	-----	U
67-64-1	Acetone	MC VOA(LS)	ug/kg	-----	UJ	-----	UJ	34	J

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Cas Rn	Chemical Name	Analytic Method	Sample Code / Sample Name / Sample Date / Unit \\ Depth	MUW-DW05		MUW-DW05-DUP		MUW-DW07		MUW-DW08		MUW-DW09	
						MUW-DW06							
				10/25/2005		10/25/2005		10/25/2005		10/25/2005		10/25/2005	
				to		to		to		to		to	
(Group Code)	(Group Description)												
1-voa-w	Volatile Organic Compounds												
75-35-4	1,1-Dichloroethene	MC VOA(W)	ug/l	0.17	J	0.15	J	0.19	J	0.64		0.61	
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	MC VOA(W)	ug/l	5.9		5.5		5.9		0.29	J	-----	U
67-64-1	Acetone	MC VOA(W)	ug/l	4.8	J	4.8	J	5.3		-----	U	-----	U
1634-04-4	Methyl tert-Butyl Ether	MC VOA(W)	ug/l	0.75		0.74		0.75		-----	U	-----	U
156-59-2	cis-1,2-Dichloroethene	MC VOA(W)	ug/l	1.8	J	1.8		1.9		-----	U	-----	U
79-01-6	Trichloroethene	MC VOA(W)	ug/l	0.54		0.52		0.54		-----	U	-----	U
75-27-4	Bromodichloromethane	MC VOA(W)	ug/l	-----	U	-----	U	0.18	J	0.19	J	0.2	J
127-18-4	Tetrachloroethene	MC VOA(W)	ug/l	3.1		2.9		3.1		0.17	J	-----	U
124-48-1	Dibromochloromethane	MC VOA(W)	ug/l	-----	U	-----	U	0.6		0.46	J	0.4	J
75-25-2	Bromoform	MC VOA(W)	ug/l	-----	U	-----	U	0.86		0.46	J	0.37	J

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Cas Rn	Chemical Name	Analytic Method	Sample Code / Sample Name / Sample Date / Unit \\ Depth	MUW-DW05 10/25/2005 to		MUW-DW05-DUP MUW-DW06 10/25/2005 to		MUW-DW07 10/25/2005 to		MUW-DW08 10/25/2005 to		MUW-DW09 10/25/2005 to	
2-sv-1-w	**Semi-Volatile Organic Compounds**												
105-60-2	Caprolactam	MC SVOA(W)	ug/l	-----	U	-----	U	-----	U	-----	U	-----	U
84-74-2	Di-n-butylphthalate	MC SVOA(W)	ug/l	-----	U	-----	U	-----	U	-----	U	-----	U
117-81-7	bis(2-Ethylhexyl) phthalate	MC SVOA(W)	ug/l	-----	U	-----	U	-----	U	-----	U	-----	U

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Cas Rn	Chemical Name	Analytic Method	Sample Code / Sample Name / Sample Date / Unit \\ Depth	MUW-DW05 10/25/2005 to		MUW-DW05-DUP MUW-DW06 10/25/2005 to		MUW-DW07 10/25/2005 to		MUW-DW08 10/25/2005 to		MUW-DW09 10/25/2005 to	
4-p/pcbs-w	**Pesticides/PCBs**												
319-86-8	delta-BHC	MC PEST(W)	ug/l	0.011	J	0.011	JN	-----	U	-----	R	-----	U
58-89-9	gamma-BHC (Lindane)	MC PEST(W)	ug/l	-----	U	0.00039	J	-----	U	-----	U	-----	U
60-57-1	Dieldrin	MC PEST(W)	ug/l	-----	U	-----	U	-----	U	-----	U	-----	U
50-29-3	4,4'-DDT	MC PEST(W)	ug/l	-----	U	0.0012	J	-----	U	-----	U	-----	U
7421-93-4	Endrin aldehyde	MC PEST(W)	ug/l	-----	U	-----	U	-----	U	0.0019	J	-----	U
5103-74-2	gamma-Chlordane	MC PEST(W)	ug/l	-----	U	-----	U	-----	U	0.0011	J	-----	U

R2-0000169

Cas Rn	Chemical Name	Analytic Method	Sample Code / Sample Name / Sample Date / Unit \\ Depth	MUW-DW05 10/25/2005 to		MUW-DW05-DUP MUW-DW06 10/25/2005 to		MUW-DW07 10/25/2005 to		MUW-DW08 10/25/2005 to		MUW-DW09 10/25/2005 to	
5-Inorg-W	**Inorganic Analytes**												
7440-70-2	Calcium	C200.7	ug/l	68800		67500		67900		43100		42500	
7440-50-8	Copper	C200.7	ug/l	215		222		257		111		212	
7439-89-6	Iron	C200.7	ug/l	-----	U	-----	U	-----	U	-----	U	-----	U
7439-95-4	Magnesium	C200.7	ug/l	34600		34200		34300		19400		19100	
7439-96-5	Manganese	C200.7	ug/l	5.3	J	5.2	J	2.4	J	0.92	J	1.4	J
7440-02-0	Nickel	C200.7	ug/l	-----	U	-----	U	-----	U	-----	U	1.7	J
7440-23-5	Sodium	C200.7	ug/l	74500		73100		74300		36300		35000	
7440-62-2	Vanadium	C200.7	ug/l	16.3	J	16.2	J	14.2	J	12.3	J	12.4	J
7440-66-6	Zinc	C200.7	ug/l	-----	U	-----	U	-----	U	-----	U	-----	U

Maunabo Wells
October 2005 Groundwater Samples
Detections Only

Cas Rn	Chemical Name	Analytic Method	Sample Code / Sample Name / Sample Date / Unit \\ Depth	MUW-GW01 10/25/2005 to		MUW-GW02 10/25/2005 to		MUW-GW03 10/25/2005 to		MUW-GW04 10/25/2005 to	
(Group Code)	(Group Description)										
1-voa-w	Volatile Organic Compounds										
75-35-4	1,1-Dichloroethene	MC VOA(W)	ug/l	-----	U	-----	U	-----	U	0.59	
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	MC VOA(W)	ug/l	5.7		-----	U	-----	U	-----	U
67-64-1	Acetone	MC VOA(W)	ug/l	4.9	J	-----	U	-----	U	-----	U
1634-04-4	Methyl tert-Butyl Ether	MC VOA(W)	ug/l	0.75		-----	U	-----	U	-----	U
156-59-2	cis-1,2-Dichloroethene	MC VOA(W)	ug/l	1.7		-----	U	-----	UJ	-----	U
79-01-6	Trichloroethene	MC VOA(W)	ug/l	0.45	J	-----	U	-----	U	-----	U
75-27-4	Bromodichloromethane	MC VOA(W)	ug/l	-----	U	-----	U	-----	U	-----	U
127-18-4	Tetrachloroethene	MC VOA(W)	ug/l	4		-----	U	-----	U	-----	U
124-48-1	Dibromochloromethane	MC VOA(W)	ug/l	-----	U	-----	U	-----	U	-----	U
75-25-2	Bromoform	MC VOA(W)	ug/l	-----	U	-----	U	-----	U	-----	U

			Sample Code	MUW-GW01		MUW-GW02		MUW-GW03		MUW-GW04	
			Sample Name								
			Sample Date	10/25/2005		10/25/2005		10/25/2005		10/25/2005	
Cas Rn	Chemical Name	Analytic Method	Unit \\ Depth	to		to		to		to	
2-sv-1-w	**Semi-Volatile Organic Compounds**										
105-60-2	Caprolactam	MC SVOA(W)	ug/l	-----	U	0.3	J	-----	U	-----	U
84-74-2	Di-n-butylphthalate	MC SVOA(W)	ug/l	-----	U	-----	U	2.4	J	-----	U
117-81-7	bis(2-Ethylhexyl) phthalate	MC SVOA(W)	ug/l	-----	U	-----	U	6.5		-----	U